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PRINCIPAL ARTICLES IN THIS NUMBER

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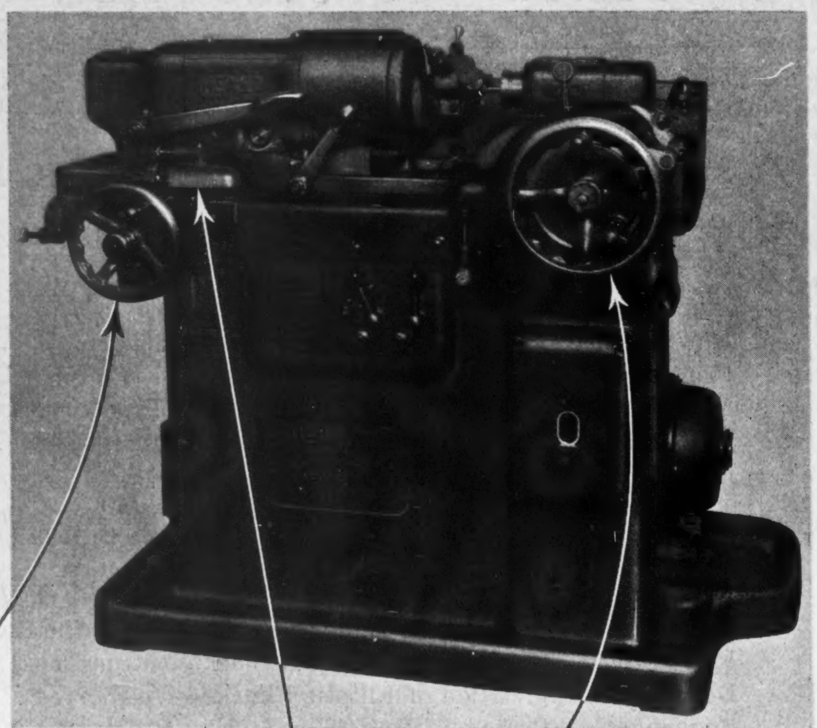

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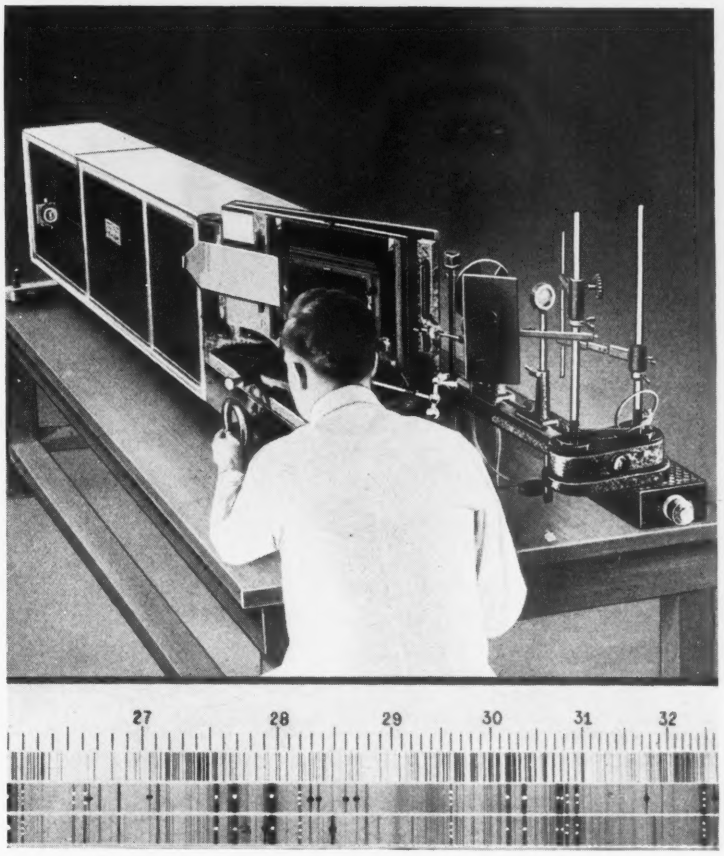
MACHINERY

Volume 39 NEW YORK, JUNE, 1933 Number 10

Star Gazing in the Shop

By CHARLES O. HERB



An Instrument Long Indispensable to the Astronomer Finds Application in the Metal-Working Industry

ALL knowledge of the sun and stars has come to us by studying their light. Many of their secrets have been revealed by the spectroscope, an instrument that produces a spectrum of the light that comes from these heavenly bodies. All the colors of the rainbow are obtained with the spectroscope, from the long-wave infra red, through the visible red, orange, yellow, green, blue, indigo, and violet, to the short-wave ultra violet. The infra red and ultra violet rays are not visible to the human eye.

Among other things, analyses of these spectra have disclosed that the sun and stars consist of iron, nickel, hydrogen, oxygen, and other familiar elements. The spectroscope showed the existence of helium in the sun and stars almost thirty years before it was found on the earth. Small wonder that the spectroscope has been called the greatest instrument ever devised by man.

If the elements of bodies trillions of miles distant can be determined by means of their spectra, why cannot the elements that exist close at hand be found out in a similar manner? This question led to the development of spectroscopes for industrial use and also of the spectrograph, an instrument like the spectroscope, except that the lines of a spectrum are recorded on a photographic plate instead of merely being seen through a telescope. While the spectrograph is not new to the physical laboratories of our universities, its industrial application is in the early stages.

In metal-working plants the spectrograph may be used for determining the elements in castings, bar stock, etc. One of its important advantages over other methods of analyzing metals is that it definitely shows all the elements in a specimen, whether they have been anticipated or not by the metallurgist. Every element is disclosed in a single investigation that requires but a few minutes.

Perhaps the widest use that the instrument will have in the metal-working field will be in checking bar stock, castings, etc., against "ideal" samples, that is, against samples of a specified composition. In a die-casting plant, the spectrograph will, for example, detect the presence of lead, cadmium, tin, or other impurities in zinc-base alloys and will also

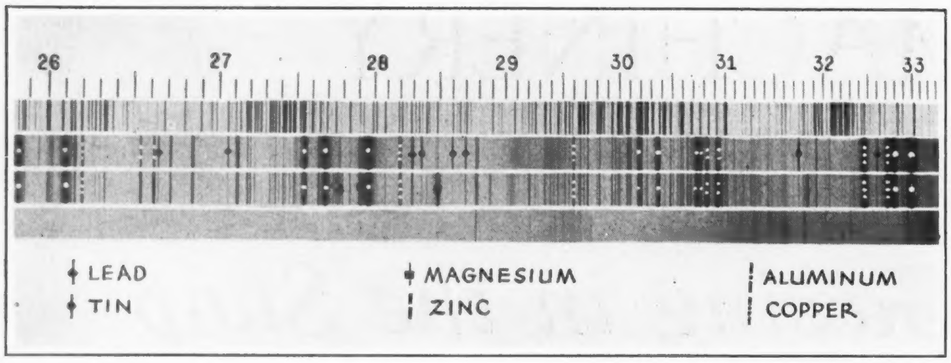


Fig. 3. Spectrographic Photographs of Two Zinc-base Die-casting Alloys (Center), Compared with a Pure Iron Spectrum (Top) and a Pure Graphite Spectrum (Bottom)

reveal the existence of such highly desirable constituents as magnesium in the alloys.

Some time ago a number of film projectors manufactured by the Bausch & Lomb Optical Co., of Rochester, N. Y., gave trouble in use, due to the film spools warping and swelling until they became so tight that they could not operate. A spectrographic photograph plate showed that the trouble was due entirely to the presence of impurities in the die-casting alloy from which the spools were made.

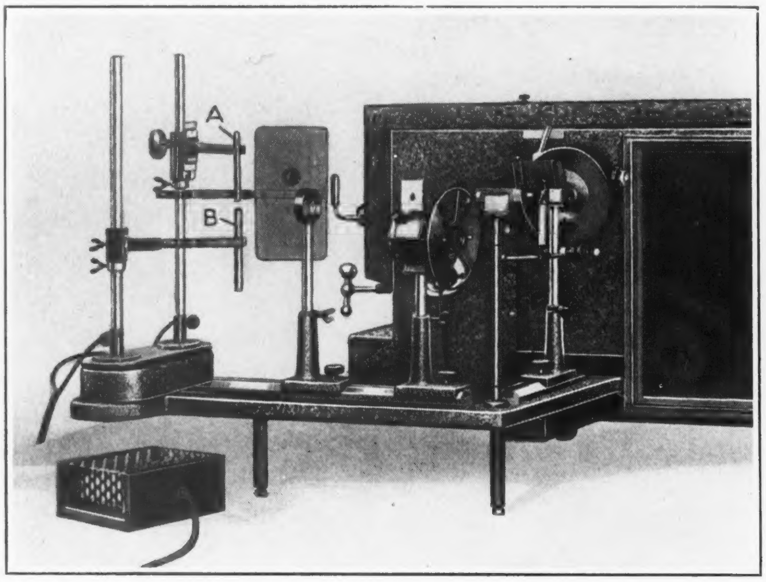


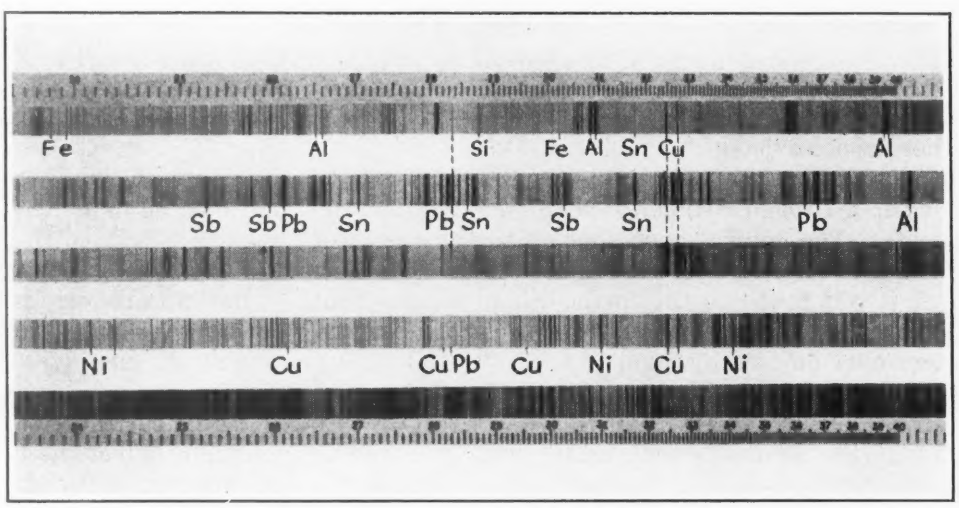
Fig. 1. The Composition of Any Metal is Determined by Drawing an Arc between Specimens A and B to Obtain a Spectrum

Another unusual investigation was conducted at the same laboratory on a piece of 1/2-inch steel tube which, it was suspected, contained, in the inner wall, an unusual contaminating element that had been absorbed from the material passing through it.

It was desired to find out if that element really had been absorbed, and if so, to what depth. After a spectrographic photograph had been taken of metal filed from the inner wall to a depth of 0.005 inch, the surface was again filed off the same amount and another photograph was taken. This procedure was repeated five times. The first photograph showed in the spectrum, definite lines of the element in question, but the amount decreased gradually until it became negligible in the fifth photograph.

Before explaining the method of analyzing the photographs obtained from a spectrograph, it would be well to describe briefly the instrument itself. We shall take as our example the large Littrow type spectrograph recently developed by the Bausch &

Fig. 2. Spectrographic Photographs of an Aluminum Alloy, Babbitt Metal, Electrolytic Copper, Monel Metal, and Iron



Lomb Optical Co. This instrument is especially suitable to the metallurgical laboratory, as it permits accurate qualitative and quantitative analyses of alloy steels, tungsten and tantalum carbides, Stellite, and other metals yielding spectra with lines crowded together. At the same time, it is equally suitable for analyzing materials with relatively simple spectra. The detection of manganese, nickel, cobalt, chromium, copper, molybdenum, silicon, aluminum, tin, tungsten, and other constituents in iron and steel alloys is rapid and positive.

For investigating any metal, samples in the form of rods that can be used as electrodes may be placed in holders, as shown at *A* and *B*, Fig. 1, so that an arc or spark can be drawn between them by electrical means. When it is not convenient to use rods, small filings of the metal to be investigated or a drop of a solution of the metal can be placed in a cavity of a pure graphite rod, which is then used as one of the electrodes. The other electrode should also be of graphite.

The light produced by the arc or spark passes through lenses and prisms in the spectrograph until the light rays have been separated according to their wave lengths, thus producing the various colors of the spectrum. Lines appear in the spectrum as a result of the different lengths of the light waves, these lines being actually images of a narrow slit through which the light has been passed. It is by observing the positions of these slits or lines in the spectrum photograph that the nature of the various elements in the specimen being investigated can be detected. By noting the intensity of the lines in comparison with a standard sample, the approximate amount of each element can be determined.

The manner in which the lines of a spectrum appear on a photograph will be seen in Fig. 2. The top spectrum is of an aluminum casting; the second from the top, of a babbitt metal; the third, of electrolytic copper; the fourth, of Monel metal; and the bottom one, of iron. The graduations at the extreme top and bottom of the illustration are scales of approximate light-wave lengths.

Below three of the spectrum bands, chemical symbols are given for various elements that have been identified by comparing the spectra with a standard spectrum obtained from some substance, such as pure iron. The iron spectrum has many lines well distributed, and the lengths of the light waves by which they are produced are known to a high degree of precision. The lines show different groups which are easily recognized by a metallurgist. It is a simple matter to locate the important lines of other elements and compare their positions with the groups of iron lines.

A standard iron spectrum is often included on each photograph taken in the spectrograph, so as to facilitate comparison. This is the case in Fig. 3, where two spectra of die-casting alloys are seen in the center. The top spectrum directly below the wave-length graduations is of pure iron, while the bottom spectrum is of graphite.

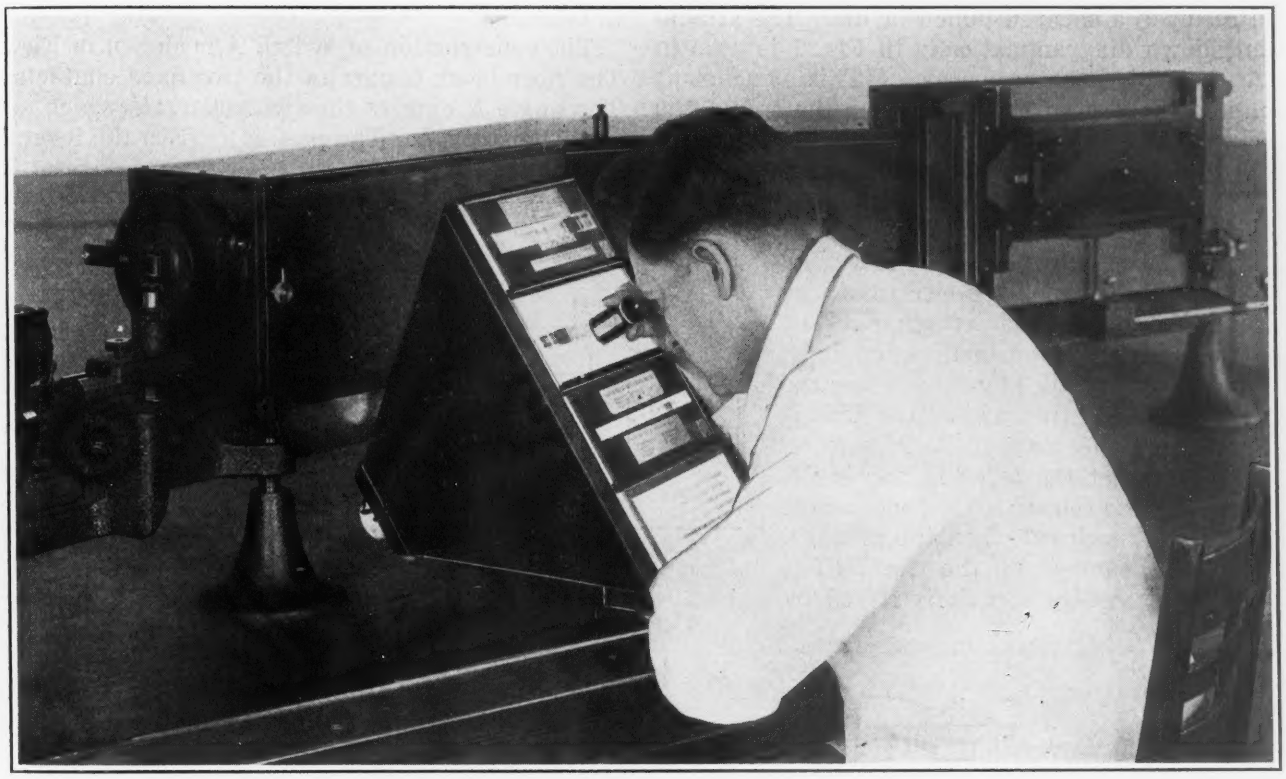


Fig. 4. Spectrographic Photograph Plates are Read by Placing Them on an Opal Glass, Lighted from the Back

Of the two die-casting alloy spectra, the lower one shows an alloy of good quality, containing magnesium, and the other is of a die-casting that failed in service. It lacked magnesium and showed excessive amounts of tin and lead. The markings were placed on the photograph with ink and chinese-white paint.

Fig. 4 shows a device developed for studying spectrographic photographs under the most favorable light conditions.

Strip-End Stop for Punch Press

On automatic punch-press work, it is customary to avoid running the end of the stock through the die, as a "half cut" may crowd one of the punches and result in a sheared punch or die. The attachment shown diagrammatically in Fig. 1 is used in order to avoid such occurrences. This attachment will stop the ram of the press when the end of the stock is within a few inches of the die, and is intended primarily for use where an operator has charge of more than one machine.

The installation consists of the special switch *A*, the solenoid or electromagnet *B*, and the piston-type switch *C*. The electrical circuit is normally open until the end of the stock passes through the switch *A*, which then closes the circuit and operates the magnet *B*. Magnet *B* operates against the lever *D*, forcing it to the right and releasing the foot-treadle *E*. Switch *C* is closed when the plunger, attached to lever *D* by the chain *F*, is withdrawn. As the circuit is closed by switch *A*, the movement of lever *D* opens the circuit at switch *C*. Thus the circuit remains closed only during the time that is required for the magnet *B* to operate.

The construction of switch *A* is shown in Fig. 2. The fiber block *G* carries the two fixed contacts *J*. The angle *K* carries the two rollers *H* which support the stock *L*. The post *M* carries the lever *N*, which is pivoted at the back end. Lever *N* supports the roller *I* and the swinging contact *O*. Contact *O* is separated from *J* while the stock *L* is passing between the rollers. As the end of the stock passes through the rollers, the lever *N* falls, closing the circuit. R. H. K.

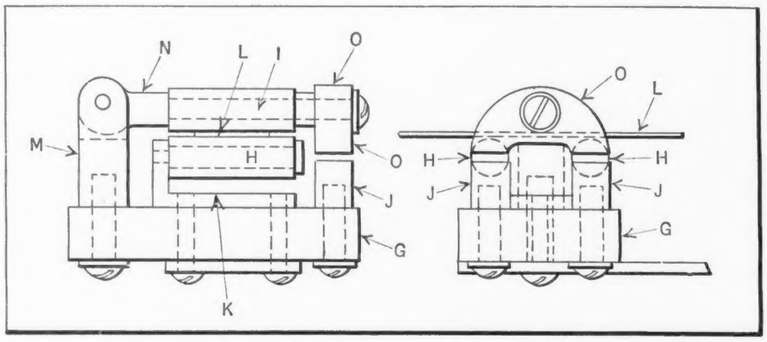


Fig. 2. Details of Switch A, Fig. 1

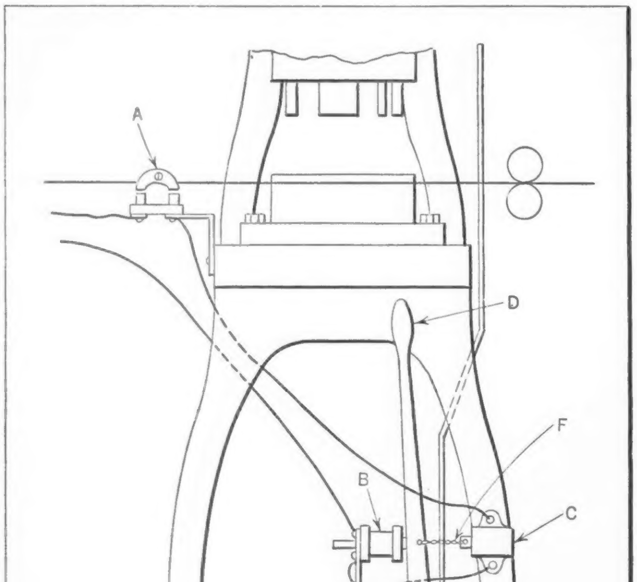


Fig. 1. Diagram Showing Arrangement for Stopping Press when End of Stock Approaches the Die

* * *

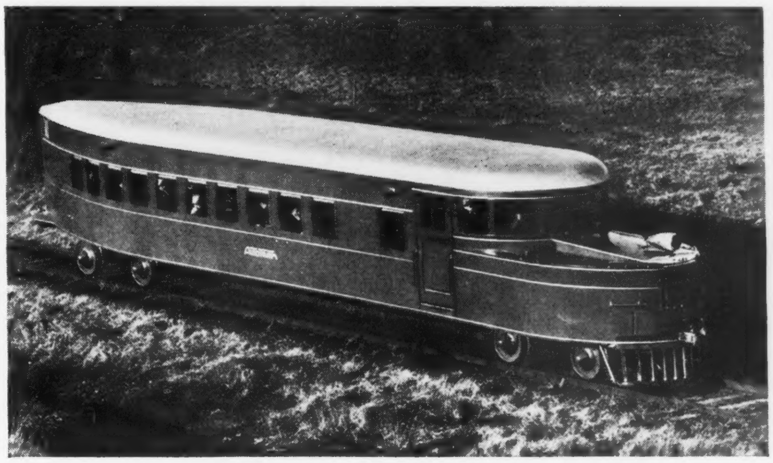
Restoring Confidence

I have resolved to put confidence in myself and by so doing expect to merit the confidence of others in me. If others will make the same resolution, it will become contagious and confidence will be stimulated to the fever heat of victory. When that happens, I will buy a new hat which I have so long needed, another conservative will buy a pair of shoes, another a suit of clothes, and presently we will all be providing ourselves with the necessities we thought we should be deprived of during this depression. The result will be that the stock on the shelves in our stores will be depleted; the storekeeper will buy more goods, the manufacturer must employ more men to make the new goods, and thus unemployment will be gradually decreased. This movement can mean nothing else than the resumption of normal business activities.—*John F. Ohmer, President, Ohmer Register Co.*

Notes and Comment on Engineering Topics

Unless a practicable synthetic rubber is discovered, it is obvious that the rubber tree plantation business will continue to flourish for a long time to come, since it is stated that it takes the equivalent of the annual output of four rubber trees to supply the rubber required in an automobile tire of average size.

According to the *Electric Railway, Bus and Tram Journal* of London, the Danish State Railway administration has announced that all future locomotive requirements for the state railways are to be met by Diesel-engined units and that no further steam locomotives will be placed in service. The Danish State Railways have employed oil-electric locomotives since 1927, and at the present time have eighteen such locomotives and seven rail cars on order. It is stated that Soviet Russia has 277 large Diesel-electric locomotives on order. Four large Diesel-electric locomotives, each of 1700 horsepower, are nearing completion at the Armstrong-Whitworth Locomotive Works at Newcastle-on-Tyne, England.



A Single-unit Gasoline-propelled Railway Car, Suggested as a Solution of the Railways' Passenger Traffic Problem. The Car Shown was Built by the Clark Equipment Co., in Cooperation with the Aluminum Co. of America, and is Constructed Almost Entirely of Aluminum Alloys, Saving 18,000 Pounds in Weight

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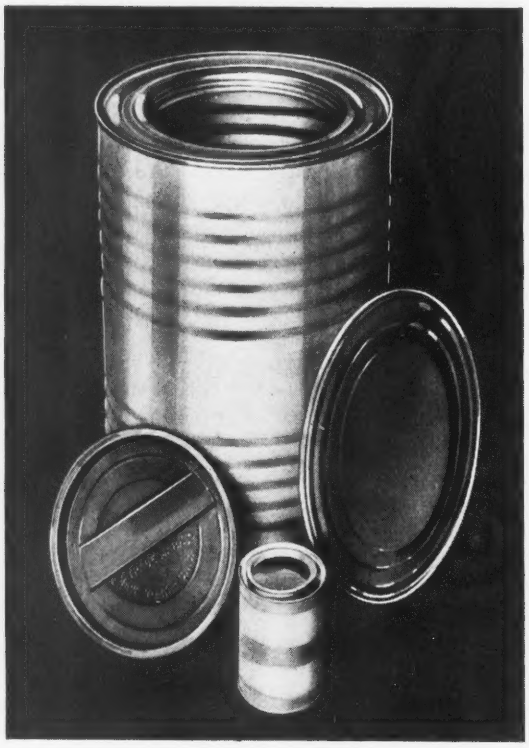
What is believed to be the world's largest hollow forging was recently made at the works of Thomas Firth & John Brown, Ltd., at Sheffield, England. The forging is to form the reaction chamber for a petroleum-cracking unit. The finished chamber has an over-all length of 48 feet, an outside diameter of 6 feet 7 inches, and an inside diameter of 5 feet 11 inches. Its total weight is 66 tons. It was forged from an ingot weighing 170 tons, through which a 25-inch hole was bored, after which the ingot was expanded to its full diameter before finish-boring in a lathe having an 8-foot swing and a bed 70 feet long. As an indication of the accuracy of the forging operation, it may be mentioned that a maximum of only 7/8 inch of material had to be removed to finish the bore to the correct diameter.

Balsa wood is used as an engineering material for several purposes—notably in the manufacture of aircraft and boats and for sound-proofing and heat insulation. The main characteristic of this wood is its extreme lightness, due to the openness of the grain and the presence of empty cells. The average weight per cubic foot is from 7 to 8 pounds. How light this is will be understood by comparing it with cork, which varies from 11 to 13 pounds per cubic foot. The source of balsa timber is central and northern South America, the best variety coming from Ecuador. The growth of the balsa tree is extremely rapid, a tree 50 feet in height and 3 feet in diameter requiring but four to five years of growth.

An Austrian inventor, Jakob Rantasa of Vienna, has constructed what appears to be a practical motor sleigh, which makes it possible to traverse roads covered by very deep snow. The load of the sleigh rests on runners, so that the vehicle glides easily over the snow, but a specially designed caterpillar serves as a drive and is adjustable according to the road and snow conditions encountered. The sleigh is of such construction that it can be transformed, in the spring, with a very slight adjustment, into a light caterpillar car or tractor, for traversing bad roads and steep gradients.

Hard-Facing Reduces Die Costs

Dies and Parts of Drum-Making Machinery Made of Machine Steel with Cutting Edges and Wearing Surfaces Hard-Faced Not Only Cost Less but Also Give Longer Service



VERY gratifying results have been obtained by hard-surfacing dies and parts of machinery subject to excessive wear at the plant of a large manufacturer of calcium carbide. The hard-faced dies illustrated are used in the production of steel drums, such as shown in the heading illustration. The use of machine steel instead of tool steel for these hard-faced dies has effected a considerable reduction in both the material and the machining costs. The hard-facing alloy in the form of Haynes-Stellite rods, 5/16 inch in diameter, was applied to all cutting edges by oxy-acetylene welding.

Examples of Hard-Faced Cutting Dies

The dies shown in Fig. 1 were hard-surfaced on the cutting edges indicated by the arrows, and then ground to their finished sizes. This group of parts includes sheet-steel slitting knives; a notching die; tucking wheels before and after grinding the hard-faced edges; a double-seamer head for making drums 12 1/2 inches in diameter; and a forming ring for drums 18 1/2 inches in diameter.

At *A*, Fig. 2, is shown a double-seamer head for a sheet-steel drum 12 1/2 inches in diameter. These seamer heads were originally made from a high grade of tool steel costing about 35 cents per pound. When the wearing edges were worn below the gage standard, it was necessary to discard the entire head, which weighed about 11 pounds. This head, made of tool steel, lasted three to four months.

The present practice is to make the entire piece of machine steel, costing 5 cents per pound, and tip the wearing edges with hard-facing material. The machine-steel head will last indefinitely or until the design is changed, because when the wearing edge becomes so worn that it will not pass the inspection gage, it is again hard-faced and ground to standard size.

An important feature of hard-faced dies is the uniform hardness of the cutting edges. The heat-treatment of tool steel often results in slight non-uniformity, so that the parts must be reworked to eliminate soft spots. This is never necessary with hard-faced parts, since the deposited hard-facing alloy is always of uniform hardness.

The cutting ring for making sheet-steel drum seals, 12 1/2 inches in diameter, is shown at *B*, Fig. 2. This ring is made of machine steel with the wearing edges hard-faced. It weighs about 27 pounds. Two views of a sheet-steel drum side-seamer tucking wheel are shown at *C* and *D*. These parts were formerly made of an extra quality tool steel at a cost of approximately $11 each. The wheel at the left side of the illustration shows the rough application of the hard-surfacing material on the wearing edge, while the view at the right shows the finished wheel after grinding.

Four old wheels were tipped with wear-resisting alloy and ground to standard size at a cost of about $5, including labor and material, or an average cost of $1.25 each, as compared with $11 each for the finished tool-steel wheels. The life of these wheels has been materially increased by the use of the hard-surfacing material and the cost has been decreased.

The shear blade at *E*, for trimming the bodies of 12 1/2-inch diameter sheet-steel drums, is made of machine steel and the cutting edge is built up with the abrasion-resisting alloy. These blades were previously made of high-carbon tool steel and cost $18.75 each. The first cost has been appreciably reduced and the life of the blade materially increased as a result of adopting the hard-faced construction.

Drill bits for drilling 1-inch holes, 3 inches deep, in amorphous carbon electrodes used in the production of calcium carbide are shown at *F*. The upper view shows a bit with the hard-surfacing material roughly applied to the cutting edge, while the lower view shows the finished bit after the cutting edge has been ground. These bits were formerly made of tool steel. The tool-steel drills would drill one or two holes before resharpening became necessary.

Wear-resisting alloy, as now applied to the cutting edges of these bits, makes it possible to drill six holes before regrinding.

The sheet-steel slitting knives shown at *G*, Fig. 3, are made of tool steel and formerly required considerable grinding in order to keep the cutting edge keen. Recently it was suggested that abrasion-resisting material be applied to the cutting edges. This not only greatly reduced the maintenance cost of the knives, but also cut down the idle time necessary for resharpening.

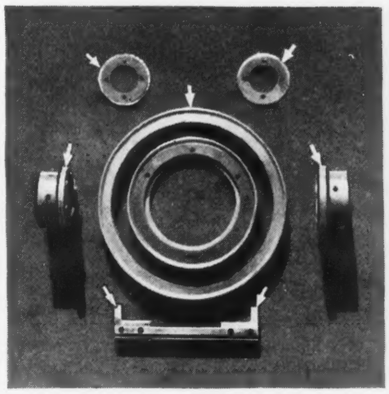


Fig. 1. Dies with Hard-surfaced Cutting Edges for Cutting Sheet Steel

A solid Haynes-Stellite double-seamer wheel for making 12 1/2-inch diameter sheet-steel drums is shown at *I*, Fig. 3. This wheel was formerly made of high quality tool steel at a cost of approximately $10, and performed a double seaming operation on about

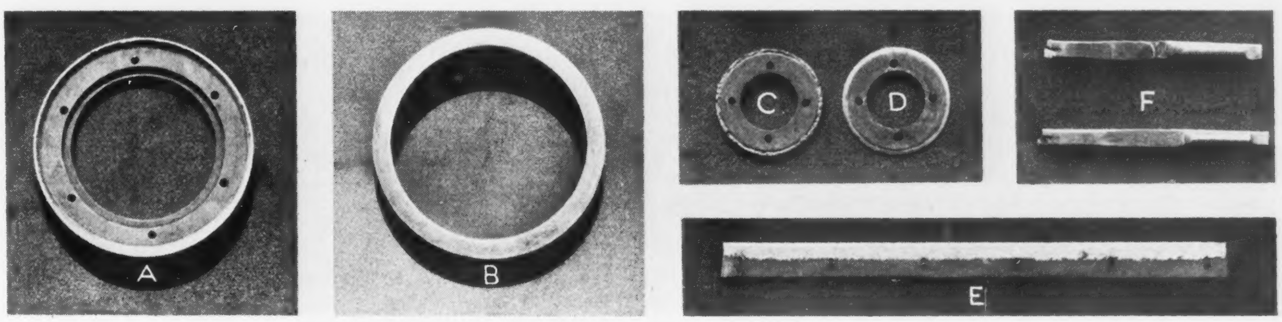


Fig. 2. (A) Double-seamer Head for Steel Drum (Hard-facing Increased Life of This Die from Four to Eighteen Months). (B) Hard-surfaced Cutting Ring, 12 1/2 Inches in Diameter. (C and D) Hard-surfaced Side-seamer Tucking Wheel before and after Machining. (E) Shear Blade of Machine Steel with Hard-faced Cutting Edges. (F) Hard-faced 1-inch Drill Bits (These Bits Drilled 12 Holes in Carbon Electrodes without Redressing, as Compared with Two Holes for Tool-steel Bits)

41,000 sheet-steel drums. A wheel was then made of solid abrasion-resisting material at a cost of about $35. This wheel now turns out from 350,000 to 400,000 drums before it needs to be replaced.

The notching die for a 12 1/2-inch diameter sheet-steel drum, such as shown at *H*, weighs 6 1/2 pounds and was formerly made of tool steel. It represented a total loss when the cutting edge was worn away. The entire piece is now made of machine steel, and the cutting edge is tipped with wear-resisting alloy and ground to the finished size. These dies last from one and one-half to two years.

The heavy-duty hooks shown at *J* are used for lifting calcium-carbide chills, the approximate weight of each chill being 3500 pounds. The view at the left of the illustration shows the rough application of hard-surfacing material to the tip of the hook, and the view at the right shows the finished hook. This application of hard-facing material has greatly increased the life of these hooks and reduced their cost to a considerable extent.

Other parts that have been successfully hard-surfaced include gages for edging shears; corrugating rolls; grooving dies; drum-burring wheels; side-

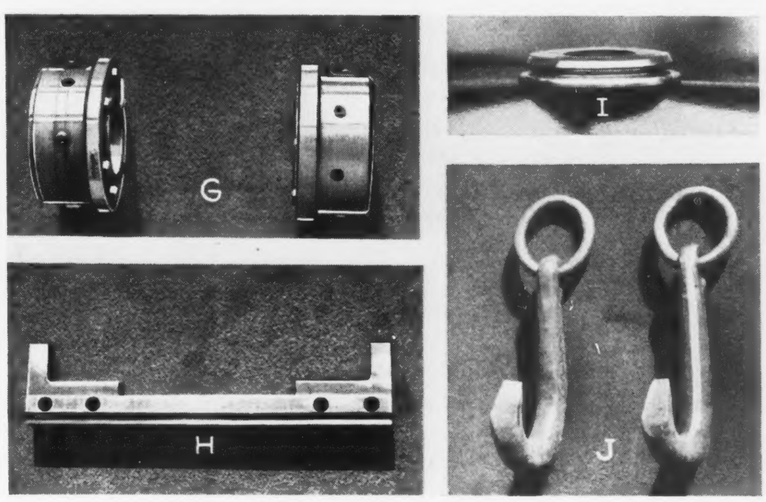


Fig. 3. (G) Hard-surfaced Knives for Sheet-steel Slitting Machine. (H) Hard-surfaced Notching Die. (I) Double-seamer Wheel of Solid Stellite (This Wheel Produces at One Conditioning Four Times as Much Work as the Steel Wheels that were Previously Used). (J) Hard-surfaced Heavy-duty Hooks for Lifting Calcium-carbide Chills

seaming wheels; and top threading dies for 100-pound drums.

One advantage of using machine steel as a base metal for the dies described was that it does not tend to warp as easily as tool steel when the blowpipe flame is applied. Occasionally, warping of the steel part may occur, but it is easily corrected by reheating certain portions of the tool in such a way as to equalize the internal stresses.

Method of Applying Hard-Facing

Before applying the hard-surfacing material, the wearing parts should be carefully cleaned by machining or grinding the surfaces to be hard-faced, giving them as smooth a finish as possible. All this work on the surfaces of the parts should be done very carefully, leaving no thin, sharp corners and providing fillets if the hard-facing material is to be deposited in grooves.

In applying the hard-surfacing alloy to steel, a blowpipe flame with a slight excess of acetylene is used. The base material is then heated to a sweating heat at the surface and the hard-facing alloy is flowed on. Following the application of this material, the part can be ground to the correct size by using suitable grinding wheels.

A summary of the advantages of hard-surfacing in the plant using the tools described shows: A notable increase in the life of hard-faced parts between reconditionings, with resulting decrease in shut-downs for replacements; savings through substitution of common machine steel for the expensive tool steel formerly required; a large reduction in the number of new parts required, due not only to increased life between reconditionings, but also to the fact that the same steel part can be reconditioned many times by simply adding more hard-facing alloy.

* * *

Inspecting Welds with Gamma Rays

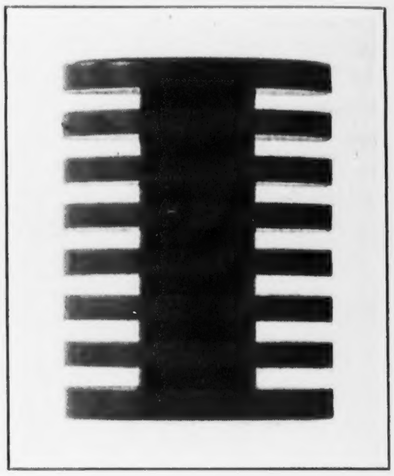
Some interesting developments in the detection of flaws in welds by means of the gamma rays emitted by radium were outlined by Gilbert E. Doan, associate professor of physical metallurgy, Lehigh University, in a paper read before a recent meeting of the International Acetylene Association. Although the use of radium for this work appears to be in the experimental stage, its future possibilities were indicated by several radiographs. One radiograph showed clearly the shrinkage cracks in a keel-knuckle casting for a 10,000-ton cruiser. These internal cracks were at a point where the steel was 6 inches thick. Another radiograph clearly indicated a hole 1 1/2 inches deep and 3 inches in diameter near the center of a pile of steel plates 10 inches thick.

The use of the gamma rays for inspecting welds, if successfully developed, would have the advantage over the X-ray method of not requiring any machinery, a capsule of radium salt being all that is necessary.

Cutting Compound for Machining Hard Rubber and Plastics

By V. W. WELLS, Engineer
E. F. Houghton & Co., Philadelphia, Pa.

With the increased use of hard rubber, plastics, and other resinous products, the problem of threading and machining these materials has been a source of trouble in many plants. Various concerns have done a great deal of experimenting before they have been able to get a smooth finish without gumming the cutting tool. Owing to the soft nature of these materials, it is usually desirable to allow greater clearance on cutting tools than would be used in machining steels. The main problem, however, is to get a cutting oil that will prevent gumming of the tools and will assist in producing a smooth finish.



A Special Cutting Lubricant, Used in Machining this Hard Rubber Part, Prevents Tool from Gumming and Gives a Fine Finish at High Speed

An example of a hard rubber part that had to be turned and deeply grooved is shown in the illustration. It was found very difficult to produce a smooth finish on the sides of the grooves without gumming the tools and machine gibs. The concern making these parts experimented with many types of cutting oils, such as straight oils, soluble oils, kerosene, mixtures of kerosene and soluble oil and water, but without success. They finally tried a sulphonated type of soluble oil. It was found that, with a 10 to 1 mixture of water and this type of soluble oil, an excellent finish on the parts could be obtained and no trouble was experienced with gumming of the tools or gibs. This solution has also been used successfully for grinding, threading, and other machining operations on both hard rubber and synthetic plastics.

* * *

Roller Friction Clutches—Correction

In the article "Design and Application of Roller Friction Clutches," published in April MACHINERY, the statement is made in the first paragraph on page 513: "Feeds of this kind frequently require an adjustment by increments of 1/10 inch or less." This should have read "1/100 inch or less."

DIMENSIONS, WEIGHTS, AND TEST AND SAFE LOADS FOR WROUGHT-IRON CRANE CHAIN*

Based upon American Society for Testing Materials Standard Specifications 1930

Nominal Size of Chain Bar, Inches	Actual Size of Chain Bar, Inches	Nominal Dimensions of Links, Inches: Outside Length	Outside Width	Inside Length	Inside Width	Nominal Length of 100 Links, Inches†	Nominal Weight per 100 Feet, Pounds†	Proof Test Load, Pounds‡	Break Test Load, Pounds¶	Safe Working Load, Pounds
1/4	9/32	1 27/64	1	55/64	7/16	86	78	1767	3535	1060
5/16	11/32	1 11/16	1 3/16	1	1/2	100	115	2760	5520	1655
3/8	13/32	1 29/32	1 7/16	1 3/32	5/8	109	166	3975	7950	2385
7/16	15/32	2 5/32	1 5/8	1 7/32	11/16	122	220	5415	10,830	3250
1/2	17/32	2 13/32	1 13/16	1 11/32	3/4	134	275	7072	14,145	4240
9/16	19/32	2 3/4	1 15/16	1 9/16	3/4	156	350	8947	17,895	5370
5/8	21/32	3	2 3/16	1 11/16	7/8	169	430	11,047	22,095	6630
3/4	25/32	3 7/16	2 9/16	1 7/8	1	188	615	15,900	31,800	9540
7/8	29/32	4 1/16	3 1/16	2 1/4	1 1/4	225	820	21,622	43,245	12,960
1	1 1/32	4 5/8	3 7/16	2 9/16	1 3/8	256	1045	28,275	56,550	16,950
1 1/8	1 5/32	5 3/16	3 15/16	2 7/8	1 5/8	288	1310	33,400	66,800	20,040
1 1/4	1 9/32	5 5/8	4 5/16	3 1/16	1 3/4	306	1600	41,250	82,500	24,750
1 3/8	1 13/32	6 7/16	4 11/16	3 5/8	1 7/8	363	1930	49,900	99,800	29,910
1 1/2	1 17/32	6 15/16	5 1/16	3 7/8	2	387	2335	59,350	118,700	35,600
1 5/8	1 21/32	7 9/16	5 7/16	4 1/4	2 1/8	425	2740	69,750	139,500	41,800
1 3/4	1 25/32	8 5/16	5 13/16	4 3/4	2 1/4	475	3180	80,800	161,600	48,450
1 7/8	1 29/32	9 1/16	6 5/16	5 1/4	2 1/2	525	3650	92,750	185,500	55,300
2	2 1/32	9 13/16	6 11/16	5 3/4	2 5/8	575	4100	105,500	211,100	63,300

*Data given applies to wrought-iron chain for slings, hoists, steam shovels, and marine uses, and for all other cases where an all-iron chain is desired. The chain shall be free from any admixture of iron scrap or steel and shall be lap fire-welded.

†The length per 100 links and the weight per 100 feet shall not vary more than 4 per cent from the figures given. In determining the chain length, a load not exceeding 10 per cent of the proof test load shall be applied to take up the slack.

‡All chain is proof-tested by being subjected to the loads given in the table; when the chain is so tested, it must not show any defects.

¶Test specimens from the finished chain shall conform to the break test loads given in the table. The test specimen in this case shall be not less than 2 feet long. The elongation in a length of from 12 to 18 inches to the nearest link, shall not be less than 15 per cent.

MACHINERY'S Data Sheet No. 251, New Series, June, 1933

LOAD CAPACITIES OF TWO-ROW RADIAL BALL BEARINGS

Bore Diam., Millimeters*	Outside Diam., Millimeters*	Width, Inches	Ball Diam., Inches	No. of Balls per Row	R.P.M. and Approximate Range of Loads, in Pounds, for Different Makes†: 100	500	1000	2000
15	42	3/4	1/4–9/32	10–11	925 1900	650 1100	475 875	300 700
17	47	7/8	5/16	10	1100 2500	775 1200	600 975	400 775
20	52	7/8	5/16	11–12	1275 2300	900 1375	700 1100	475 875
25	62	1	3/8	12	1775 3700	1250 2175	1000 1700	600 1350
30	72	1 3/16	7/16	11–12	2700 4700	1900 2700	1400 2150	800 1700
35	80	1 3/8	1/2	12	3400 5700	2400 3300	1850 2600	1200 2000
40	90	1 7/16	17/32–9/16	12–13	4200 6200	2900 3700	2300 2500	1450 2000
45	100	1 9/16	19/32–5/8	12–13	5100 7900	3550 4600	2750 3700	1700 2900
50	110	1 3/4	11/16	12	6000 9200	4200 5300	3300 4250	2000 3400
55	120	1 15/16	3/4	12	7100 11000	4950 6200	3850 4850	2350 3800
60	130	2 1/8	13/16–27/32	12	8200 13000	4900 7700	3900 5000	2950 3050
65	140	2 5/16	7/8–29/32	12	9400 13700	6600 8500	5100 6300	3400 5000
70	150	2 1/2	15/16–31/32	12	12000 16000	8500 9600	6300 7000	3750 5600
75	160	2 11/16	1	12–13	11100 18300	6500 10700	5100 7400	4100 4900
80	170	2 11/16	1 1/16	12	15000 20000	10300 11800	7800 8200	4650 6500
85	180	2 7/8	1 1/8	12–13	16700 22400	11300 13100	8600 9100	6100 7100
90	190	2 7/8	1 3/16	12	18500 24700	12900 14400	9300 10000	....
95	200	3 1/16	1 1/4	12	20200 29400	14100 15800	10000 11000	....
100	215	3 1/4	1 5/16	12	22000 32000	15500 16800	.....	....
105	225	3 7/16	1 3/8	12	24000 35000	.....	.....	....

*For converting millimeters into inches, see table on page 1538 of MACHINERY'S HANDBOOK, sixth and later editions.

†Load ratings of commercial bearings vary considerably for different makes. The figures given in the accompanying table are intended to be used only as a general guide in preliminary designing. The exact rating should be obtained from the manufacturers of whatever bearing is to be used.

MACHINERY'S Data Sheet No. 252, New Series, June, 1933

Progress in Automobile Production Methods

New Practice in Producing Highly Accurate Connecting-Rod Bearings by Diamond Boring and Honing is Typical of the Improved Methods Now Being Introduced in Large Automobile Plants

By F. C. DUSTON

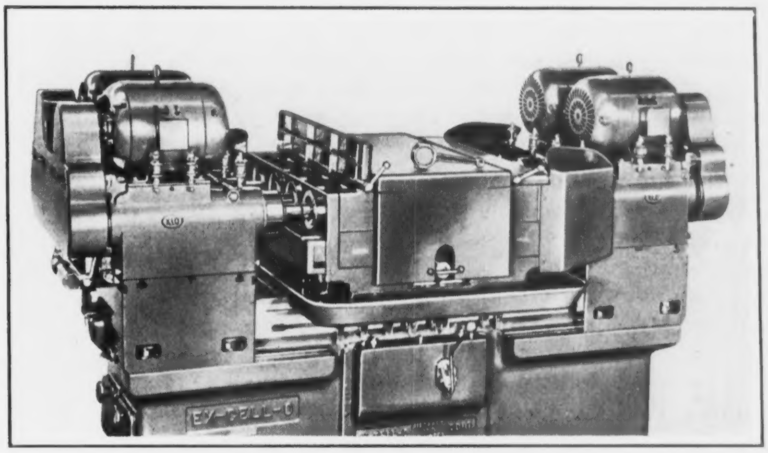


Fig. 1. Connecting-rod Bearings are Finish-bored within Close Limits of Accuracy on This Machine at High Production Rates

MUCH has been accomplished in the development of automobiles during the past year. Higher speeds, with greater safety, dependability, and comfort, feature the 1933 models, which are unquestionably more attractive in appearance than those of any previous year. When production records and prices were at their peak, the automobile manufacturers were interested primarily in methods of increasing production, and the machine tool builders were concerned chiefly in building machines to meet those requirements.

Today, conditions are somewhat different. Every automobile manufacturer is now concentrating on the problem of improving the appearance and performance of his new models. To do this successfully under existing price conditions requires the best machine tools and equipment obtainable. Many of the latest improvements incorporated in this season's cars were made possible by recent developments in machine tools and production equipment. The descriptions of these developments published in MACHINERY form a record of the trend in production methods that is of vital importance to the automotive designer, production engineer, and machine tool builder.

Building of Better Automobiles Made Possible by Improved Machine Tools

With the increasing demands for higher engine speeds combined with higher operating efficiency and durability, it became necessary to improve the accuracy and finish of many bearing surfaces. Higher piston speeds, for example, made it necessary to give the cylinders a smoother finish and hold them to closer limits. The various types of cylinder boring, grinding, reaming, honing, and burnishing machines and tools developed for this purpose have been described in MACHINERY as soon as they were perfected.

The average purchaser of a low- or medium-priced car today appreciates the fact that he is obtaining a car that will surpass even the highest priced cars built several years ago. He may not know why this is so, but the designers and production engineers who cooperated in the development of the new models know. They know, for example, that the bearings in connecting-rods bored at the rate of 4800 rods per eight-hour day, as described in October MACHINERY, page 110, are in all probability better and more accurate than those of the connecting-rods in the highest priced cars produced a few years ago. This is only one example among hundreds of how a new or improved machine tool is producing, in a few seconds, what hours of skilled hand fitting and lapping could scarcely equal.

With the great variety of machines now available, one of the most difficult tasks of the production engineer is the routing of different jobs or the choice of machining methods. The design of the part, the production schedule, the kind of material used, the heat-treatment employed, and the methods of assembling are only a few of the many factors to be considered in choosing the machining procedure for any particular part.

The Machining Problem Presented by the New Type Steel-Back Replaceable Bearing

The new type of replaceable bearing now being used quite extensively in the connecting-rods of automobile engines presents a rather unusual machining problem. These steel-back bearings have a very thin cross-section; and, consequently, the accuracy of the bearing, after assembling, depends on the accuracy of the hole in the connecting-rod in which it is assembled.

The method of machining the connecting-rod

bearings of a new V-type eight-cylinder engine developed by one of the largest motor-car manufacturers, deserves special attention from the viewpoints of accuracy, finish, and rate of production. These particular connecting-rods have a floating bearing, the internal surface of which turns on the crankshaft while the external surface turns in the connecting-rod bore. This type of bearing calls for a very high degree of finish, with an accuracy tolerance of 0.0003 inch. These requirements are easily met by the equipment described in the following paragraphs.

Diamond-Boring Followed by Honing Gives Desired Results

The bearings in the connecting-rods of the V-type eight-cylinder engine referred to, are first bored on the diamond-boring machine shown in Fig. 1. This machine is one of the latest models developed by the Ex-Cell-O Aircraft & Tool Corporation. The operating principles and general design of this type of precision boring machine have been described previously in MACHINERY, several automobile production applications, for example, having appeared in October, 1931, page 112.

This new machine has eight spindles and is so arranged that two connecting-rods can be loaded in the rough-boring positions while the finish-boring operations are being performed on the two rods previously rough-bored. The finish-bored rods are removed and replaced by rough-bored rods while the rough-boring spindles are in operation.

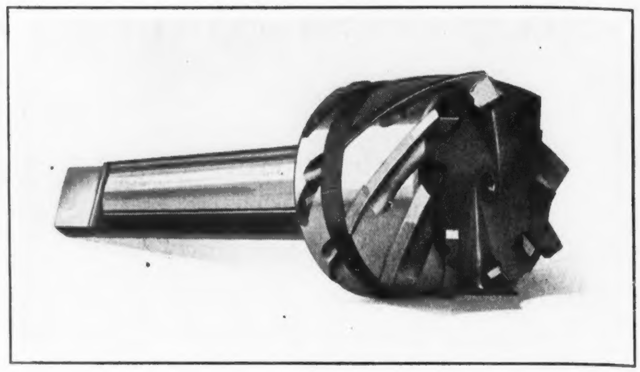
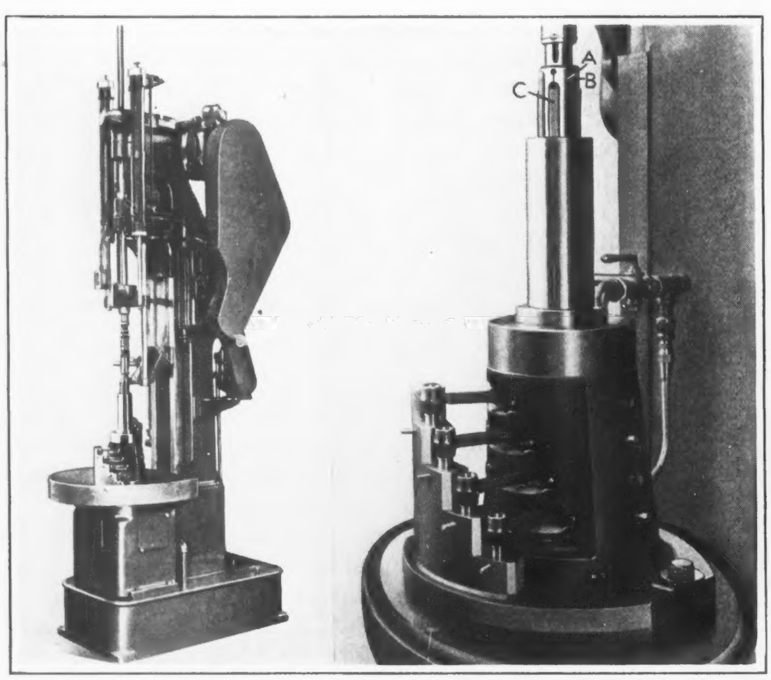


Fig. 4. Tool Developed for Reaming Holes in Large Ends of Connecting-Rods at a Cutting Speed of 240 Revolutions per Minute

After being rough- and finish-bored, the connecting-rods go to the hydraulic honing machine shown in Fig. 2, where the bearings in the large ends of the rods are honed. This Barnes Drill Co.'s honing machine is equipped with a Micromatic hone and operates on the same principle as the large four-spindle machine used in honing the cylinders of a V-type cylinder block, described in October, 1932, MACHINERY, page 111.

Accurate Connecting-Rod Bearings are Produced by Broaching and Honing

Broaching, followed by honing, is being used successfully by another large automobile manufacturing concern for finishing connecting-rod bearings. The connecting-rods, in this case, are used in the engine of a new model car now being produced in large quantities.



Figs. 2 and 3. The Connecting-rods Finish-bored on the Machine Shown in Fig. 1 are Honed, Four at a Time, on this Machine. At the Right is Shown a Close-Up View of the Honing Tool and Work-holding Fixture

The manufacturer requires the bearings in the larger end of these rods to have a uniformly smooth surface, and specified that the amount of stock left by the broach for removal by honing should not exceed 0.0005 to 0.001 inch. The object in setting the allowance for honing at a minimum was to keep the cost for honing stone replacements as low as possible, and yet, at the same time, provide for sufficient honing to insure the removal of all tool marks.

In order to maintain the uniformly close limits required in this case, the Ex-Cell-O Aircraft & Tool Corporation designed special broaches with replaceable finishing shells. These broaches are 28 inches long and 2.042 inches in diameter, and remove 0.022 inch of stock on the diameter of the bearing at the large end of the rod. The broach teeth are designed to take a light cut per tooth and to avoid forming ring marks on the work. Care was also taken to so design the broach as to prevent distortion of the work, so that the hole would not be out

of round more than 0.0002 inch after broaching. Careful checking has shown that the average bearing broached by these tools is only about 0.0001 inch out of round. The hole is also required to be broached at right angles with the face of the rod within 0.001 inch. As soon as the finishing shell on the broach begins to wear, it is replaced. These shells are made to produce a high finish, as well as to hold the work within close limits of accuracy.

New Reamer Developed for Connecting-Rod Bearings Holds the Work to Close Tolerances

A new inserted-blade reamer having the blades located at a spiral angle of approximately 45 degrees has been developed by the Barber-Colman Co., for use in reaming the holes in the crankpin ends of connecting-rods and other steel parts having similar requirements. The blades are held by the standard pin and wedge mounting used by this company, as shown in Fig. 4. The blades are adjusted straight out from the center and do not slide along an incline. After being sharpened on a Barber-Colman reamer sharpener, the 2.042-inch reamer illustrated produced crankpin holes in connecting-rods that were held straight and round within 0.0001 inch and square with the face within 0.0015 inch, as checked on an electrical gage. From 0.0006 to 0.001 inch of stock was left for honing to a polished surface. The anchor holes for replaceable bearings, as well as the oil-holes, proved no obstacle to this reamer.

The reamer was run at a speed of 240 revolutions per minute, or 125 surface feet per minute. At this speed, the 1 1/4-inch length of the hole was reamed in fifty seconds. This production time could be reduced to ten seconds by using multiple fixtures. The outstanding features of this operation are the high cutting speed and the remarkable finish obtained in steel.

Floating Work-Holder and Piloted Hone Permit Four Rods to be Honed in One Operation

While the features of construction and operation of the Micromatic Hone Corporation's honing tool and fixture shown in the enlarged view, Fig. 3, are radically new, the basic principles employed in honing the bearings of four connecting-rods simultaneously are the same. The main difference is that the work is allowed a certain amount of "float," while the honing tool is piloted in the fixture.

Previous attempts to hone several pieces at one time have been unsuccessful, principally because of the difficulty experienced in keeping the bores parallel when the pieces were clamped rigidly together. Any slight deviation from squareness in the side faces of the work gave an accumulated error that threw the bores out of parallel or out of alignment. It was also found difficult to clamp small parts sufficiently tight for any machining process without excessive distortion when attempting to maintain limits of accuracy below 0.0005 inch.

With the new work-holder or fixture shown in Fig. 3, each connecting-rod is allowed to float independently of the others. The bores to be honed are held in perfect alignment on resilient wiper-guides *A*, mounted in the body *B* of the honing tool in such a manner as to obviate the necessity for rigid clamping.

The honing stones *C* are so mounted that they float in relation to the body of the hone and the work. This floating action compensates for any unevenness in the stone wear and prevents the stones from disturbing the alignment provided by the wiper-guides. The resilient guides *A* are extended beyond the honing stones *C* in order to keep two or more connecting-rods in alignment. With this arrangement, the tool automatically centers the parts from the holes to be honed without regard to any other locating points. This permits the work to be rechucked after inspection, in order to remove a small amount of stock, should that be necessary.

The honing tool is so designed that the stones are expanded after entering the bore and contracted automatically before being withdrawn. The initial pressure with which the honing stones are applied to the work is spring-regulated. The expansion is limited to the control-diameter size. The vertical reciprocating motion of the hone is accompanied by a rotary motion. After the hone has made a predetermined number of strokes, the machine is stopped automatically by a stroke-counting device. Coolant is supplied by a pump from a reservoir in the machine base.

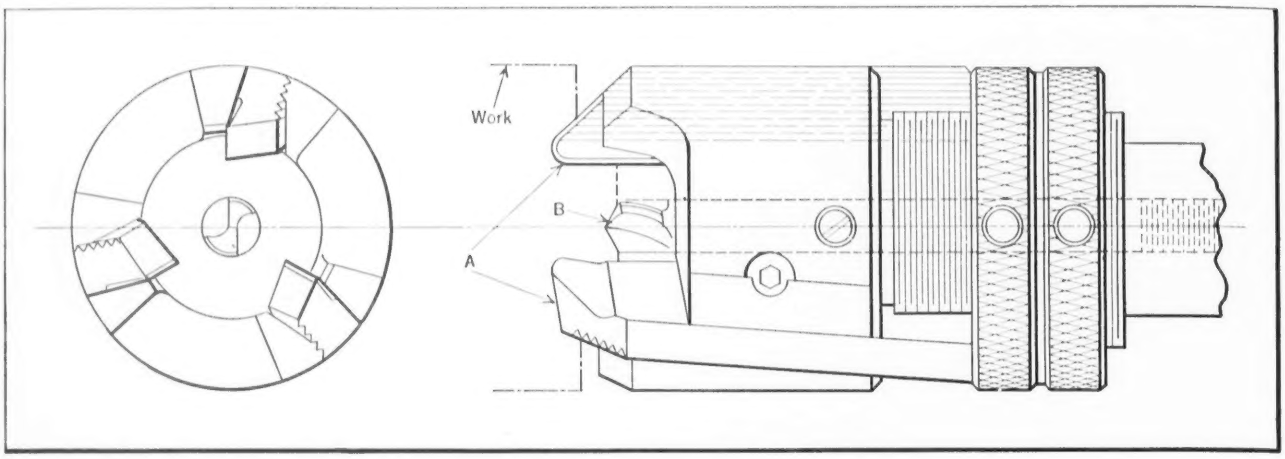
Tests Show Accuracy of Honing Process

In order to determine the accuracy limitations of the honing method, sixteen connecting-rods having known errors were selected for tests. These connecting-rods included some with bores purposely diamond-bored out of round more than 0.0015 inch, and others with a taper of 0.001 inch and a maximum difference in diameter size of 0.0017 inch.

After honing these connecting-rods, the bores were checked with a very accurate Swedish indicator gage calibrated to 0.0001 inch. The readings showed the honed bearings to be accurate well within a limit of 0.0003 inch for roundness and straightness. The difference in diameter size was reduced to within 0.0002 inch.

Time studies made under average production conditions with the equipment described showed that 0.0007 to 0.0012 inch of stock can be removed from a ground hole in an actual honing period of twenty-five seconds, with a floor-to-floor time of forty seconds, while upward of 500 rods can be honed with one set of honing stones.

It is possible to remove from 0.001 to 0.0015 inch of stock from a diamond-bored hole in forty-five seconds actual operating time or one minute from floor to floor, and from 350 to 400 holes can be honed per set of honing stones.



Multiple-Operation Tools of the Hollow-Mill Type

Fig. 1. A Special Hollow-mill Designed for Cutting a Circular Groove in the End of a Shaft and Simultaneously Spot-drilling the Shaft

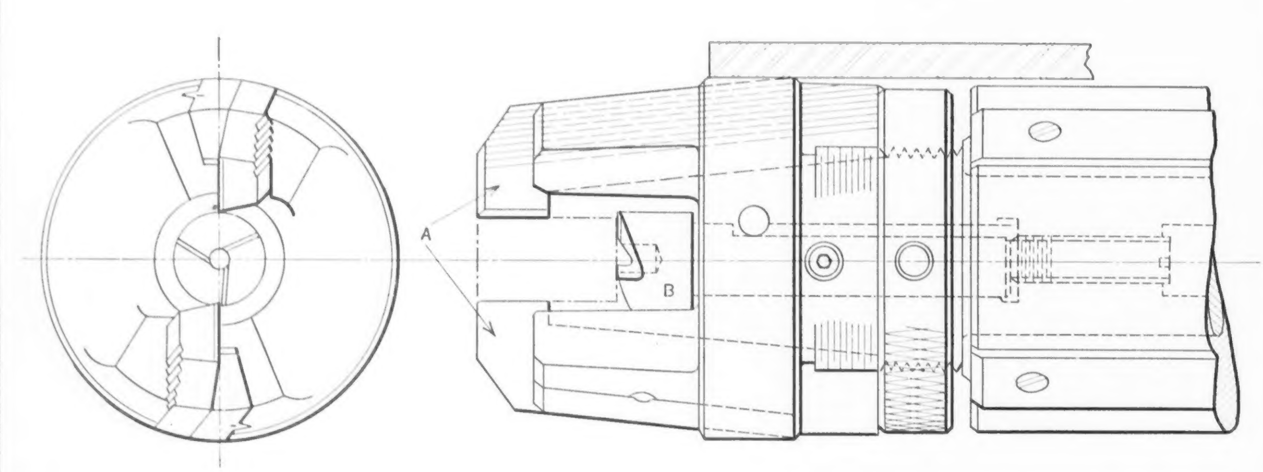
TOOLS that simultaneously take hollow-milling and either drilling, countersinking, facing, or similar cuts are specially designed by the Gairing Tool Co., Detroit, Mich., to suit individual jobs. They are all variations of the standard Types J and H hollow-mills described in June, 1932, MACHINERY, and in practically all of them serrated cutter-blades of the standard types are used.

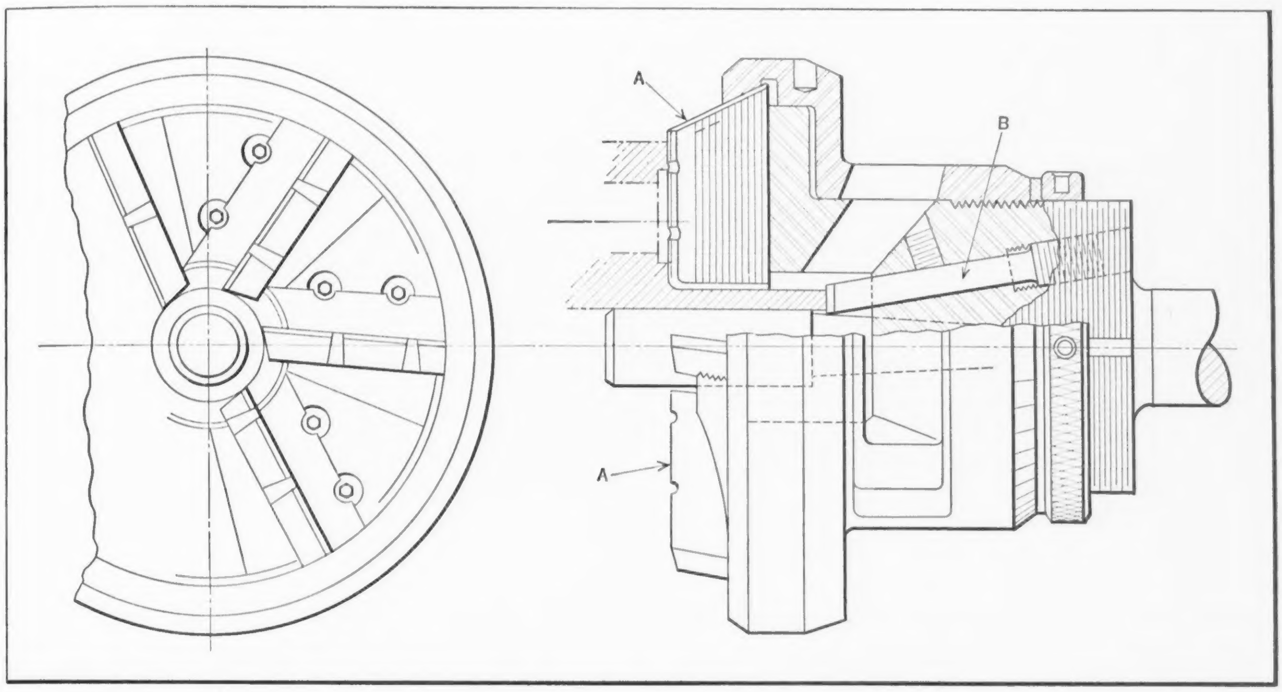
A tool designed for cutting a circular groove in the end of a shaft and at the same time spot-drilling the shaft is illustrated in Fig. 1. The grooving is done by the three adjustable blades *A* and the drilling by the tool *B*. One of the features of this tool, as well as of the others here described, is the large amount of clearance provided in the tool-holder to take care of chips.

The tool shown in Fig. 2 consists of a hollow-mill made up of the two cutter-blades *A* and a smaller solid hollow-mill *B*. Blades *A* take roughing cuts on a shaft, while cutter *B* faces off the end of the shaft, leaving a small-diameter projection in the center. The next operation on this part consists of using a somewhat similar tool having three hollow-mill cutter-blades for finishing the surface roughed by blades *A* and a combination center drill and countersink which removes the central projection from the end of the shaft and center-drills the shaft.

Fig. 3 shows a tool designed for turning a fairly long hub on a malleable-iron casting, facing the hub, and sweep-facing a number of bolt-hole bosses arranged around a circle that is concentric with the hub. The turning of the hub and the sweep-facing

Fig. 2. Hollow-mill with Two Adjustable Cutter-blades for Rough-turning a Shaft End and a Small Solid Hollow-mill for Facing it





of the bosses is performed by the six cutter-blades *A*, while the facing of the hub is done by a single tool bit *B*. This tool bit is provided with a threaded shank for close adjustment.

Fig. 3. Special Tool for Hollow-milling a Hub on a Malleable-iron Casting, Sweep-facing a Number of Bolt-hole Bosses, and Facing the End of the Hub

The Effect of Diamond Boring and Honing on Bearing Lubrication

By F. C. DUSTON

To eliminate friction and prevent wear between two metal parts that are in sliding or rotating contact, an unbroken film of lubricating oil must be maintained between the bearing surfaces. If the surfaces have a rough finish, that is, if there are miniature hills and valleys that cause breaks in the oil film, the crests of the hills will be worn away rapidly, causing a looser fit in cylindrical parts.

Considering the lubrication problem, it would seem that a cylinder or connecting-rod bearing should be finished by some method that will reduce the height of the hill portions of the bearing surfaces to the point where the depth of the valleys is less than the thickness of the normal oil film under operating conditions. After this has been accomplished, it is questionable whether or not further smoothing down of the hill crests is desirable, as it is conceivable that the oil film may not adhere so readily to a perfectly smooth surface, with no valleys to serve as oil-retaining grooves or cavities. With this in mind, we can analyze the conditions obtained by diamond boring followed by honing.

Boring with a fine-pointed diamond or tungsten-carbide tool, using a fine feed and high speed, is one of the most accurate and economical methods of producing a straight and round hole. The finish-bored surface consists of a very fine, continuous helical groove and a continuous helical ridge or thread. The depth of the groove may be less than the thickness of the oil film, but at the same time it may serve, in a measure, as an oil reservoir or container. Under many conditions, such a bearing surface would have excellent wearing qualities and would not be improved by further smoothing.

Now, let us assume, however, that the helical groove left by the diamond-boring tool is slightly less in depth than the thickness of the oil film, but that the crest of the thread formed by the grooves is rather sharp and necessarily a little "feathery." If the oil film is broken, the sharp crest with its comparatively small supporting area will be worn down quickly, causing the bearing to become loose. However, the crest of the thread-like bearing surface can be economically removed by honing, thus producing scratches or valleys that are, say, only one-quarter of the depth of the valley left by the boring tool. We now have a smooth surface with a greater bearing area, but we need not carry the honing operation far enough to entirely remove the helical groove left by the boring tool; the groove will still serve to retain oil and assist in maintaining the oil film.

Tubing Made with a Thin Outer Layer of Stainless Steel

THE stainless steel headlight tie-rod on a popular-priced automobile consists of tubing having a wall of ordinary steel 1/8 inch thick, with a covering of strip stainless steel only 0.015 inch thick. The stainless steel strip is rolled so firmly on the plain steel, which is also rolled into tubular form, that the two metals, in effect, become one. With this design, the advantages of stainless steel are obtained at a fraction of the cost of tubing made completely of stainless steel.

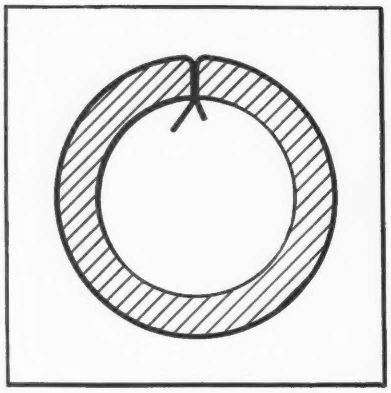


Fig. 1. Cross-section of Tubing with a Heavy Wall of Ordinary Steel, Covered by a Thin Layer of Stainless Steel

An enlarged sectional view through the tubing is shown in Fig. 1. The stainless steel covering is represented by the heavy outer line. The outside diameter of the tubing is about 11/16 inch. The wall is rolled from stock 1 13/16 inches wide and the stainless steel from stock 2 inches wide, in the same operation. The steel wall of the tubing is rolled continuously and cut off in lengths of 25 3/4 inches at the end of the operation. As the stainless steel covering is about 1 inch shorter on each end than the wall, it has to be cut to length at the beginning of the operation and properly positioned along the strip of plain steel.

The rolling of the tubing is performed in the machine shown in Fig. 2, which was built by the McKinney Tool & Mfg. Co., Cleveland, Ohio. Both strips of stock are pulled into the left-hand end of the machine by rolls, the plain steel being above the stainless steel strip. As the front end of each piece of stainless steel passes the first set of forming rolls it strikes a trip-finger which operates a clutch and engages a shearing mechanism at the left-hand end of the machine. This mechanism then travels with the strip of stainless steel and at the same rate of speed. As it moves along, a knife blade swings down and cuts the strip to the required length.

As soon as the stainless steel has been sheared, the rolls that pull it into the machine stop revolving long enough to allow for the difference in length between the stainless steel and the plain steel. The shearing mechanism then immediately returns to the starting position, ready for the next cut.

Five pairs of horizontal forming rolls bend the edges of the stainless steel strip around the heavier stock and crimp them sufficiently so that the stainless steel is carried along by the plain steel. The first set of rolls also squeezes the upper corners of the heavier stock so that they can later be closed up

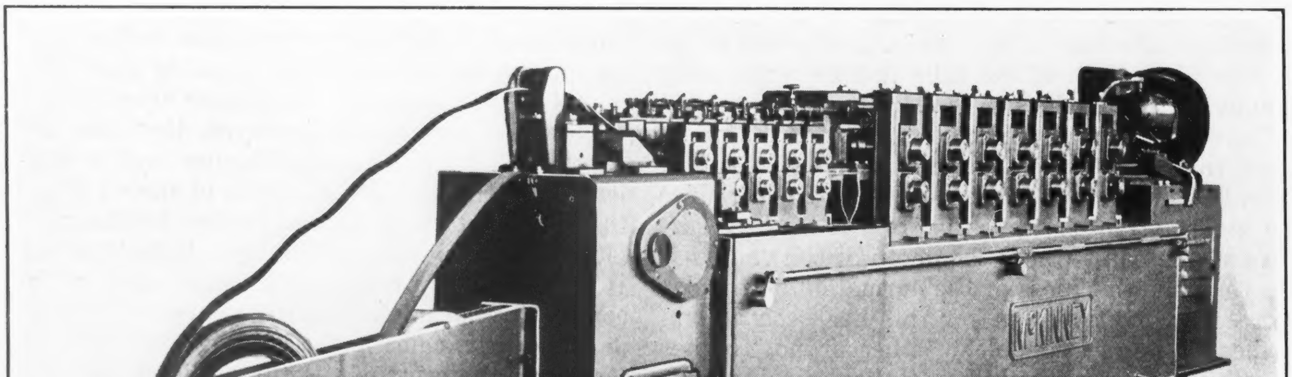


Fig. 2. Rolling Machine, in which Two Strips of Stock are Formed into Tubing that Has a Thin Outer Covering of Stainless Steel, as Shown in Fig. 1

tightly in forming the tube. Emulsified oil is used to facilitate the forming steps.

When the heavy steel stock, with the stainless steel attached to it, leaves the fifth pair of rolls in the first group, it passes to a second group consisting of seven pairs of horizontal forming rolls, a pair of auxiliary horizontal rolls, and three pairs of vertical rolls which act as straighteners.

When each piece of stainless steel, now completely rolled around the heavier stock, reaches a certain point at the right-hand end of the machine, it trips a finger which actuates the saw carriage seen in Fig. 3. Immediately, this carriage starts moving in synchronism with the tube, and a fast revolving circular saw cuts the tube to the required length. A pair of jaws grips the tube firmly for the operation. When the cut is finished, the jaws open, the finished tube drops on a conveyor, and the saw carriage returns to the starting position. The automatic cut-off increases the production about 100 per cent.

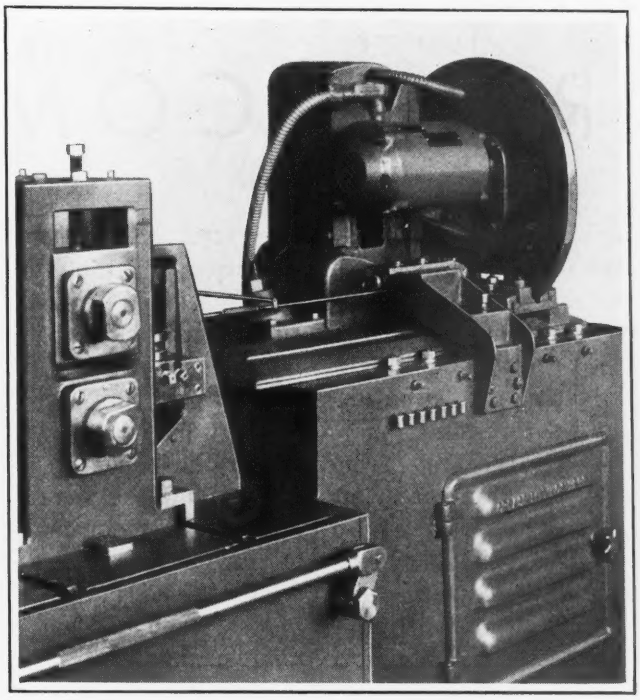


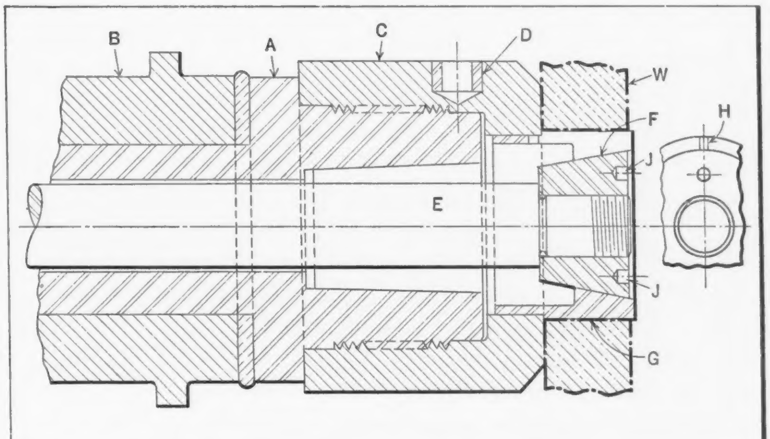
Fig. 3. A "Flying Saw" at the Right-hand End of the Machine Cuts off the Tubing to the Required Length for Use as Automobile Headlight Tie-rods

As the stainless steel strip is fed into the machine it has a dull finish. When the finished tube leaves the machine, the stainless steel has the polish of cold-rolled steel. About fifteen tie-rods are produced a minute, which is equivalent to over thirty-two feet of tubing a minute.

Expanding Arbor with Interchangeable Sleeves of Different Sizes

When turning gears, pulleys, or similar parts, some kind of special fixture or arbor is often mounted on the spindle nose of the machine to serve as the work-holding means. These devices are of various types ranging from simple arbors to quite elaborate fixtures. The design shown in the accompanying illustration has two basic features that commend it—first, simplicity of construction, and second, the ease and cheapness with which it is changed from one size to another.

The spindle *A* of the machine revolves in bearings *B* of the lathe, and the arbor or fixture *C* screws on the end of the spindle, with which it revolves. A steel rod is placed in the hardened steel bushing *D* for tightening or removing the arbor.



Arbor that can be Supplied with Interchangeable Expanding Bushings to Fit Bores of Different Sizes

Through the center of the spindle is a draw-back rod *E*, to which a tapered plug *F* is attached. This draw-back rod is actuated by a handwheel at the extreme left end of the spindle (not shown). The tapered plug *F* is caused to slide in and out of sleeve *G* by operating the handwheel.

The work *W* is mounted on sleeve *G*. This sleeve has three slots cut part way through it, shown at *H* in the partial end view. Thus the action of the tapered plug expands the sleeve, causing it to grip the work. Sleeve *G* can be replaced quite readily for a change of size by unscrewing plug *F* with a spanner wrench that fits the two holes *J*. The same expanding plug *F* can be used with the various sizes of work-holding sleeves *G*.

H. M.

EDITORIAL COMMENT

Rising Prices Give Fair Promise of Industrial Recovery

The tendency toward rising prices for both industrial and agricultural products is the most cheerful sign on the commercial horizon. Nothing could stimulate our industries more than a gradual improvement in the price situation, with rising prices all the way from the raw materials to the finished products. Such an increase in prices should not be resisted by attempts to bring undue pressure upon the seller. A profitless industry is an unhealthy industry, and a profitless enterprise is a danger to industrial stability.

The present price level is so abnormal that the sooner industry can get away from it the better. Wages that will provide a steady purchasing power cannot be paid unless industry itself is properly paid for its services.

Therefore, any tendency toward rising prices should be hailed with satisfaction. It is likely to prove the first step on the road to a genuine business recovery.

The Value of Steel is Not All in the Analysis

It has been pointed out repeatedly that uniform quality in steel is not assured by having a uniform chemical analysis. Different brands of steel having identical chemical composition may have quite different cutting capacities, for example. This applies to steels not intended for cutting purposes as well. The qualities of steel depend as much upon the methods of making it as upon the composition.

To illustrate this point, a steel-maker once made this homely comparison: "If you gave the same amount of flour, sugar, butter, milk, and eggs to five housewives," he said, "would you expect to get exactly the same kind of cake from each one of them? Yet, each cake would contain the same ingredients. It is the same with steel. The manner of making means as much as what there is in it."

Recently we ran across an interesting object lesson. A manufacturer required a spring for a performance for which no available type of spring steel was suitable. His metallurgist suggested a certain composition that would give the spring the required physical characteristics. By the aid of this formula, a steel manufacturer made a satisfactory product, of which several hundred tons were purchased. When the supply ran out, the purchasing agent sent to other steel manufacturers for quotations on spring steel of the analysis specified. He received many bids, some of them very low. The order was placed with two of the lowest bidders. When the steel was delivered, it was found that while it met the chemical specifications, satisfactory springs could not be made from it. Later, the purchaser had to return to the original steel producer, whose methods made it possible for him to turn out a steel that had not only the required chemical analysis, but also the necessary physical characteristics. The making of steel is still an art.

The Motion Picture Can be Made an Important Educational Medium

While hundreds of millions of dollars are spent annually on motion pictures for entertainment, a comparatively small amount is being spent on the use of this efficient means of instruction in schools and colleges. In engineering schools particularly, much information could be conveyed by motion pictures in a simple and direct manner that now must be laboriously explained verbally or by means of the printed page. A well made motion picture tells more about an engineering subject than a lengthy description. It faithfully reproduces the facts. It can be seen over and over again, if necessary, to bring out some particular point that might be missed at the first showing.

The only drawback to the use of motion pictures for educational purposes is their cost; but if it is possible to create new pictures constantly for entertainment purposes, it should also be possible to find ways and means of using them as an important educational medium.

Motion pictures of engineering and shop operations also have a value to the experienced man. It is easy to study what is going on in the performance of a certain operation when the action is repeated again and again, and motion pictures offer a means of research to engineers that is useful when improvements in methods are being sought. Obviously, the possibilities of using motion pictures in both the educational and industrial fields have by no means been exhausted.

Ingenious Mechanical Movements

Mechanisms Selected by Experienced Machine Designers as Typical Examples Applicable in the Construction of Automatic Machines and Other Devices

An Overload Release Clutch for Rotating Members

By E. NIEDERER

The release clutch shown in the accompanying illustration is of the friction type and has proved very satisfactory in protecting parts of machine drives against overloading. The device can be built directly into a spur or worm gear and requires no additional space. Hence it can be easily incorporated in a drive where no provision was originally made for such a device. The clutch is of simple design and very economical to build, since standard gears requiring only a little extra machining can be used. The friction disks used are standard Ford parts, costing less than five cents each.

Gear *A* is provided with six equally spaced holes *B* containing the pins *C*. These pins engage notches in the friction disks *E* and act as drivers. Other disks *F* are provided with lugs *H* which engage corresponding notches drilled in hub *J*. Disks *E* and *F* are free to slide on each other. They are held tightly against the web of gear *A* by hub *J* and collar *L*, the required pressure being transmitted to the hub and collar by the springs *M* on the shoulder-screws *N*. With this arrangement, gear *A*, pins *C*, and disks *E* comprise the driving member of the clutch, and disks *F*, hub *J*, springs *M*, screws *N*, and collar *L*, the driven member.

Gear Equipped with Friction Arrangement for Stopping the Driven Shaft when Excessive Loads are Applied

Any excessive torque applied to the driven shaft will cause the friction disks to slide on each other, thus stopping the rotation of the driven shaft until the excessive torque is removed. The magnitude of the torque transmitted is directly proportional to the total axial spring pressure applied on the clutch disks and their coefficient of sliding friction, and can be controlled by proper spring adjustment.

Ingenious Arrangement for Indexing Multiple-Threaded Work in an Automatic Threading Lathe

By A. S. KINGMAN

To meet the demand for an economical method of chasing quadruple threads on the short sleeves shown in Fig. 1, an automatic threading lathe was redesigned. The usual lead-screw was replaced by a cam, and the cross-feed was arranged to feed once in every fourth pass of the tool. By employing a cam and proportioning the change-gears correctly, it was possible to index the work automatically from thread to thread with each longitudinal cycle of the tool.

A diagrammatic plan view of the lathe is shown in Fig. 2. The work, indicated at *D*, is mounted on an arbor and supported in the lathe in the usual manner. The gear *A* on the spindle and gear *B* on the camshaft *K* are connected by means of an idler. On the right-hand end of the camshaft is keyed the cam *J* which imparts an intermittent reciprocating

movement to the carriage E through the bronze follower H attached to the slide G. In order to maintain contact between the follower and cam, a weight M was provided, which is connected to the carriage by a cable passing over pulley L.

The ratio of gears A and B is such that, for every revolution of the cam, the work rotates 1 3/4 revolutions. In other words, the work assumes a new angular position at the beginning of each cut. This change in position is equivalent to 90 degrees. Thus the work is indexed smoothly from thread to thread without employing a complicated indexing mechanism.

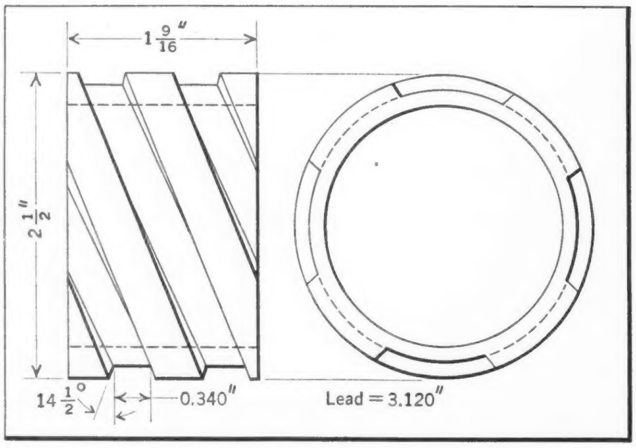


Fig. 1. Sleeve Having a Quadruple Thread Cut in the Automatic Lathe Shown in Fig. 2

The method of calculating the gear ratio and developing the cam for this particular sleeve will now be described. In Fig. 3, the line ON was drawn equal to the cam circumference, and on this line the cam was developed. Line ON was divided into seven equal parts by vertical lines numbered as indicated. Since the thread to be cut was quadruple, each one of these equal parts was assumed to represent one-fourth of a spindle turn. Thus the ratio of the spindle turn to the cam turn is 7 to 4; that is, when the cam completes one turn, the spindle makes 7/4 or 1 3/4 turns. Gears corresponding to this ratio have 40 and 70 teeth, the larger gear being mounted on the camshaft.

Now it is obvious that the part of the cam that forms the thread must be an accurate helix, the development of which is a straight line. To develop this line, a point was located on vertical No. 4, 3.120 inches (the thread lead) above line ON. Through this point a straight line was drawn from point O to vertical No. 7. It was found that stopping the thread-forming portion of the cam on vertical No. 3 provided ample carriage travel for cutting the thread.

The exact dimensions for the cam rise were found by first dividing the thread lead (3.120) by 4 to obtain the rise for one-quarter revolution of the spindle, or 0.780 inch. This rise was then multiplied by the number of spaces from O corresponding to three-quarters of a revolution of the spindle, and the total cam rise, 2.340 inches, was obtained. The lead (5.460 inches) for the working portion of the cam was found by multiplying the entire number of spaces by the rise during one-fourth revolution of the spindle.

The dwell at the top of the cam allowed time for backing the tool out of the thread before the carriage started on its return movement. The longer dwell at the bottom allowed time for moving the tool forward and for the functioning of the cross-feed. With this arrangement, the work rotates continually in the same direction. To enable multiple threads of different leads to be cut on this machine, the sizes of suitable cams and gears can be computed by the method described.

This lathe can also be used for chasing internal threads in short bores. In this case, the action of the cross-feed is reversed, so that the cutting tool will be moved toward the center of the bore at the end of each cut.

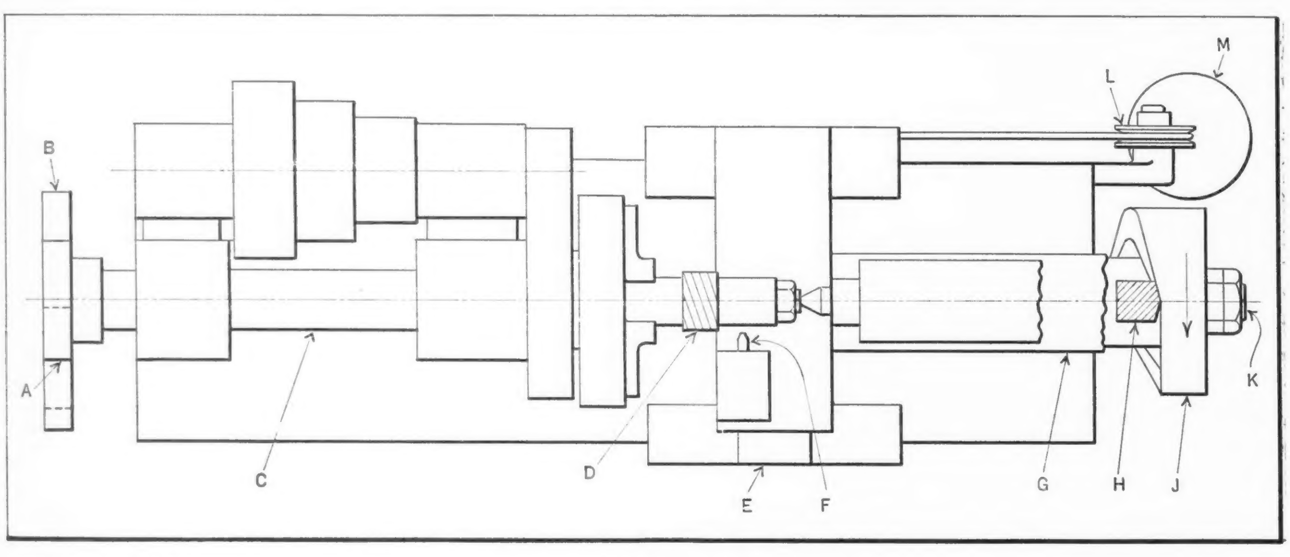


Fig. 2. Redesigned Automatic Threading Lathe in which a Simple Cam and Change-gears Serve to Index the Work Smoothly after Each Cut when Chasing Multiple Threads

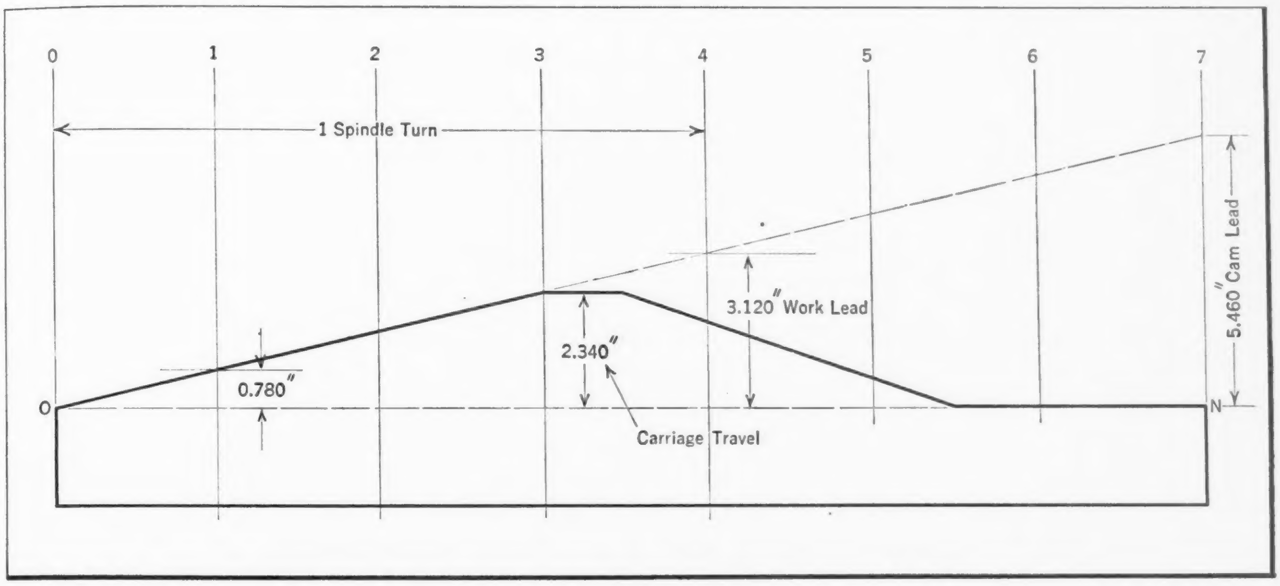


Fig. 3. Development of the Cam for Cutting the Multiple Thread on the Sleeve Shown in Fig. 1

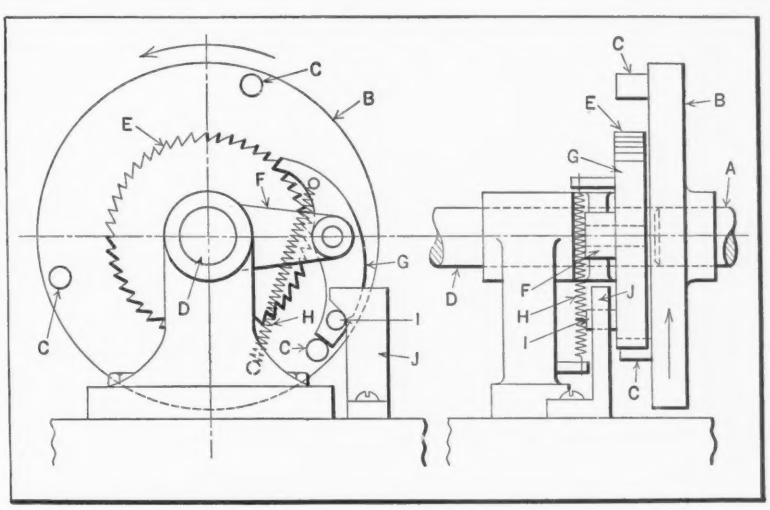
Intermittent Drive Mechanism

By L. KASPER, Philadelphia, Pa.

The mechanism shown in the accompanying illustration is designed to transmit an intermittent rotary motion to the drive shaft *D* from the constantly rotating drive shaft *A*. This intermittent movement operates the feeding device on a wire-forming machine which requires three partial revolutions of the driven member for each rotation of the driving member. Drive shaft *A* with the attached disk *B* rotates continuously in the direction indicated by the arrow. The disk *B* has three equally spaced pins *C* on one side. The ratchet wheel *E* is keyed to shaft *D*. Lever *F* carries the pawl *G* and is free on shaft *D*. Spring *H* serves to keep pawl *G* in contact with the ratchet wheel *E* and also tends to rotate lever *F* in a direction opposite to that in which member *B* is driven.

Pawl *G* is so shaped that when the actuating end is in contact with ratchet wheel *E*, the opposite end lies in the path of the pins *C*. As one of the pins *C* makes contact with pawl *G*, the pawl is carried with it, causing ratchet wheel *E* to rotate. When the pin *I* on pawl *G* comes in contact with the cam *J*, pawl *G* is disengaged from ratchet wheel *E*, which then stops moving.

Continued movement of disk *B* causes the end of pawl *G* to be further depressed by the action of cam *J* until the pawl slips under pin *C*. The two views of the mechanism show pawl *G* about to be disengaged from ratchet wheel *E*. As soon as the pawl has discontinued positive contact with pin *C*, the action of spring *H* causes pawl *G* and lever *F* to rotate in a direction opposite to that of the driving member *B*, until the upper end of lever *F* strikes the end of cam *J* which limits its movement and controls the angular movement of ratchet wheel *E*. The driving movement is repeated as each pin *C* comes into contact with the pawl.



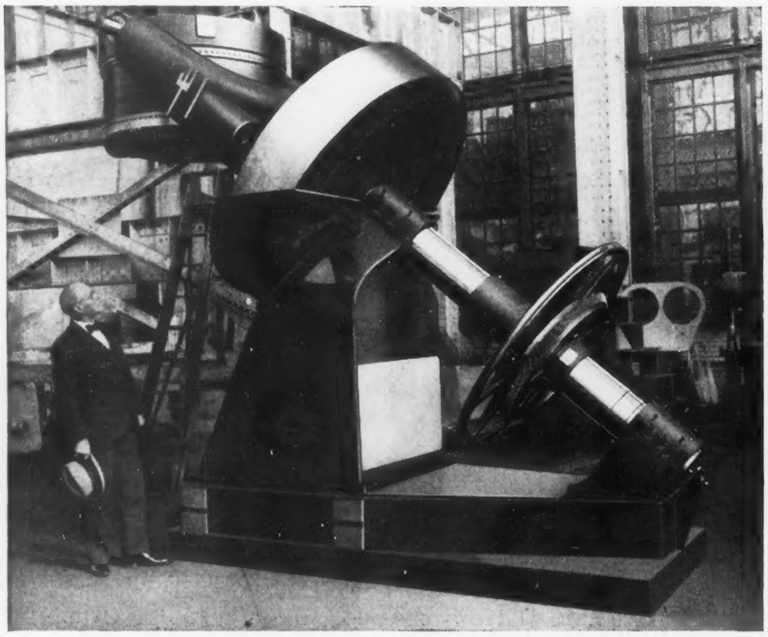
Intermittent Motion Drive Mechanism Used on Wire-forming Machine

* * *

As a result of extensive tests and research, the Lehigh Valley Railroad has purchased a number of unusual Westinghouse tractor welders for track maintenance work. The object in developing this welder was to provide a mobile power supply unit that would not require frequent transferring to and from the track, and that would not interfere with traffic or signal operations. The tractor is capable of operating along the shoulder of the track, entirely clear of trains; it can ascend slopes of 35 degrees, and can start on 45-degree side slopes.

Building a Telescope of Great Precision

One Large Shaft which Weighs Five Tons with Its Parts has a Run-out of Only 0.000025 Inch



By CHARLES O. HERB

Astronomers throughout the world are intensely interested in a new type of reflecting telescope that will probably be ready for use at the United States Naval Observatory, Washington, D. C., this summer. It is believed that this 40-inch Ritchey-Chrétien telescope will be from one hundred to two hundred times more effective photographically than existing reflecting telescopes of the same size.

One of the important advantages anticipated from the use of the new equipment is that the star images will be round and true over a large area of the photograph. With previously built reflecting telescopes, the star images are true only within a circle about 1 inch in diameter in the center of the photographic plate; all other images are distorted because the rays of light coming from the stars strike the large mirror of the telescope at an angle. Thus, if the new telescope fulfills expectations, it will permit far more accurate photographs of the heavens to be taken. One mirror will catch the light rays of the stars and a smaller mirror will reflect them to the photographic plate or to the eye.

The mounting for this telescope, which comprises practically all parts, with the exception of the mirrors and their auxiliary equipment, was built by the Baldwin-Southwark Corporation, Philadelphia, Pa. It is shown in the heading illustration being viewed by the designer, Professor G. W. Ritchey. The large shaft that carries the mirrors and various adjusting means is known as the "polar axis," because, as installed in the Naval Observatory, the axis of this shaft is parallel with the earth's polar axis.

Although the polar axis, together with the various parts mounted on it, weighs 10,000 pounds, the specifications allowed a tolerance of only 30 seconds in the angle between the polar axis and the finished top surface of the base. Actually the polar axis was assembled true with the base surface within 10 seconds. It is interesting to note that the polar axis and its parts float on mercury inside the large container at the left-hand upper portion of the base. The sheet-metal drum (Fig. 6) rides on the mercury.

Another important specification for the polar axis was that it must run true in its bearings within

Fig. 1. (Upper Left-hand View) In Turning the Journals of the Trunnion Ring, a System of Weights, Levers, and Knife-edges Kept the Work Accurately Balanced

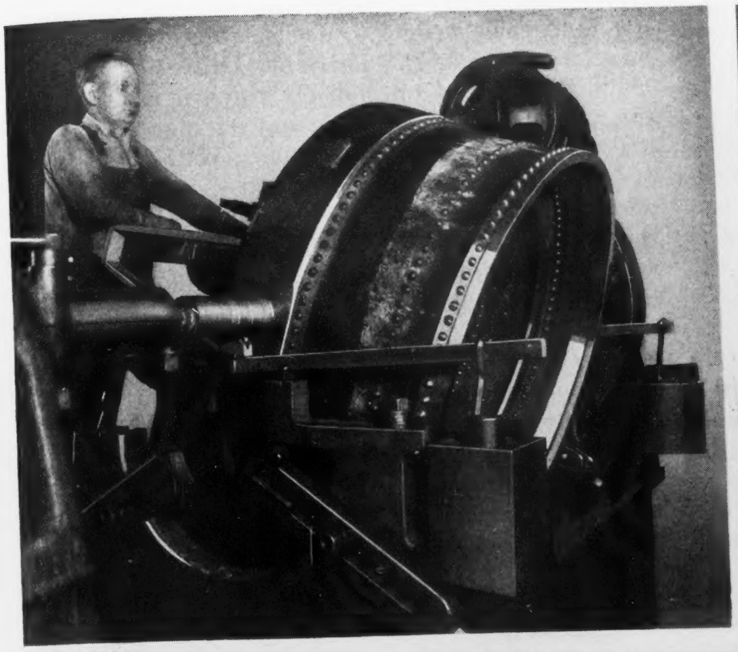
Fig. 2. (Upper Right) The Trunnion Ring was Finish-machined and the Journals Rough-turned before the Shell Tube Seen in Fig. 1 was Assembled

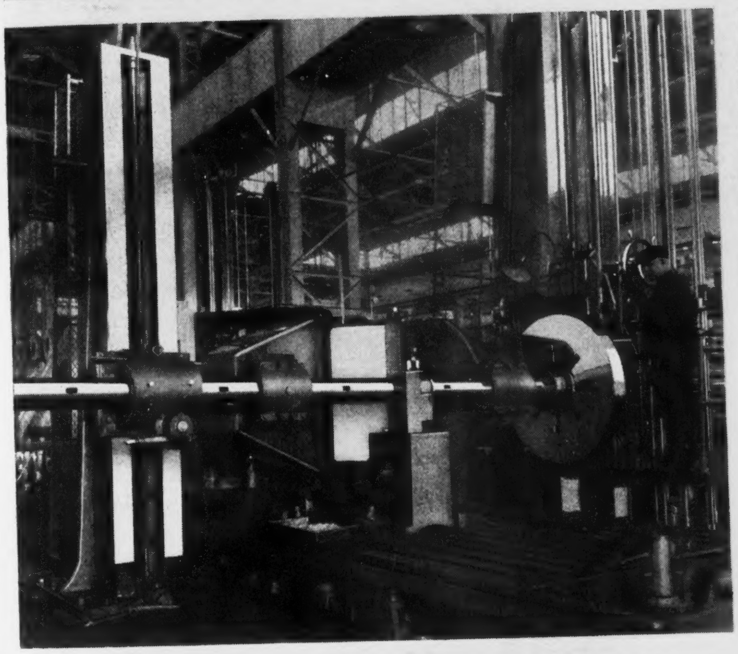
Fig. 3. (Middle Left) Finish-boring the Bearings that Hold the Polar Axis in Accurate Parallelism with the Earth's Axis

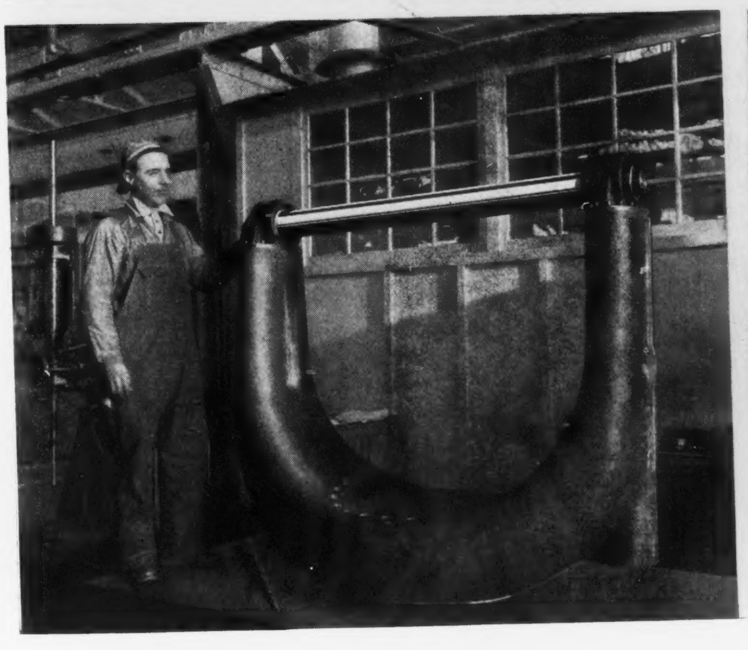
Fig. 4. (Middle Right) All Castings Had to be Correct as to Shape and Weight so as to Eliminate Any Chance of Distortion in Use

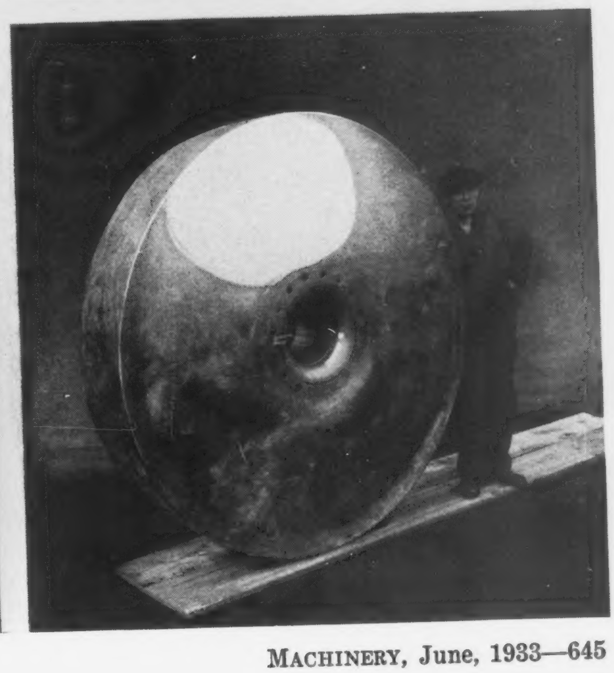
Fig. 5. (Lower Left) The Two Bearings through which the Inspection Mandrel is Extended were Held to Close Limits in Relation to a Counterbored Hole in the Fork

Fig. 6. (Lower Right) The Seven-foot Float which Rides on Mercury Consists of Steel Plates Welded around the Castings Seen in Fig. 4 and a Cast-steel Center









unusually close limits. These bearings are made of white metal, since the mercury relieves them of practically all load. The polar axis, which is approximately 12 feet long and weighs 1550 pounds, was finish-ground in a large roll-type grinding machine, while the bearings were bored with the telescope mounting set up on a horizontal boring machine, as illustrated in Fig. 3. When assembled, the run-out of the polar axis at both bearings was not more than 0.000025 inch, indicating an eccentricity of only one-half that amount.

Other important parts had to be finished to almost the same extreme accuracy as the polar axis. For example, the finished journals of the trunnion ring shown in Fig. 1 have an eccentricity of only 0.000125 inch. One of the problems in machining these journals that required considerable ingenuity in its solution was the balancing of the unit as it rotated in the lathe, due to most of the load being off center. The weight of this unit was approximately 850 pounds.

* * *

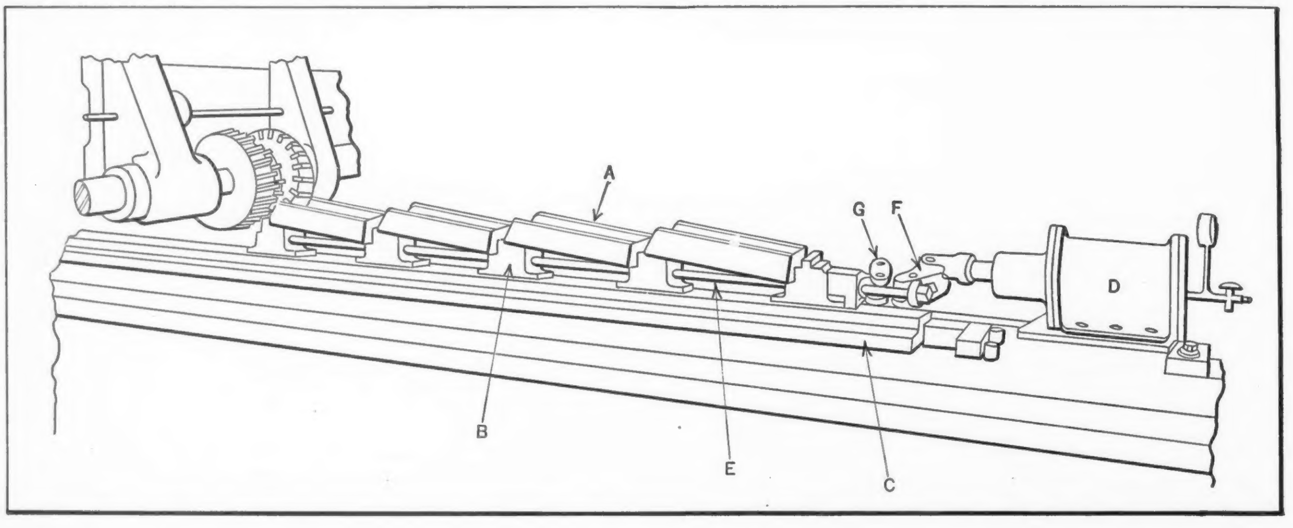
Set-Up Time for Pedestal Wedges and Shoes Reduced to Almost Nothing

By OLIVER HERBERT

In many railway shop operations, the time required for setting up the work on the machine is greater than the actual machining time. Although this is generally due to the fact that the volume of work does not warrant special jigs or other equipment, there are frequent cases where the work does come through in sufficient quantity to permit more efficient practice to be followed.

The accompanying diagram illustrates air-operated equipment developed in the Battle Creek, Mich., shops of the Grand Trunk Railway System for clamping four pedestal wedges or shoes simultaneously on the table of a planer-type milling machine. The wedges or shoes *A* are merely placed on steps of blocks *B*. These blocks are free to slide a limited amount on slab *C*, which is attached to the machine table, a tongue on each block engaging a T-slot in the center of the slab. With the wedges or shoes on the blocks *B*, a valve is operated to admit air to the rear end of cylinder *D*. Then, as the piston in the cylinder moves forward, it pulls rod *E* to the right through the action of toggle *F*.

Rod *E* is attached to the extreme left-hand block *B* and slides through the other blocks. As the rod is drawn to the right, it pulls all the blocks *B* and their work pieces with it, except for the extreme right-hand block *B*. Thus a heavy pressure is exerted on all the blocks and on the work pieces so as to hold them securely for the milling operation. The right-hand block *B* is prevented from moving through the action of a second toggle *G*, which is also operated by cylinder *D*, but in the opposite direction to the movement of toggle *F*. Slab *C* is backed up at the right-hand end by stops attached to the table of the machine. Stop-screws facilitate returning blocks *B* to their approximate loading positions when the pressure has been released from the piston in cylinder *D*.



Air-operated Device which Simultaneously Clamps Four Pedestal Wedges or Shoes on a Planer-type Milling Machine

The illustration shows the manner in which pedestal wedges are set up. The operation consists of milling the side walls of the wedges, both inside and outside, as well as the tapered surface. This surface must, of course, be held parallel with the machine table, and it is for this reason that each pedestal wedge rests on a higher step of the left-hand block than of the right-hand block. Shims are used to make the wedge surface truly level. When shoes are being milled, the opposite ends are held on steps of equal height above slab *C*.

In milling either wedges or shoes, the floor-to-floor time for the four parts averages 20 minutes. Cross-head shoes can also be handled with the same equipment. Cylinder *D* is equipped with a 10-inch cylinder and the air pressure ranges from 70 to 100 pounds per square inch.

Drilling and Tapping Both Ends of Crankshafts at the Rate of Fifty per Hour

THE illustration Fig. 2 shows a six-position fixture used on a National Automatic Tool Co.'s two-way, four-head combination hydraulic driller and lead-screw tapper for performing drilling, reaming, tapping, facing, and countersinking operations on the ends of crankshafts. The opposite ends of two crankshafts machined on this equipment are shown in Fig. 1. The right- and left-hand drilling heads are at the front and the right- and left-hand tapping heads are at the rear of the machine. The drilling heads are equipped with the Natco-Hydro uni-power system of hydraulic feed, and the tapping heads are controlled by a Natco reversing motor-drive unit.

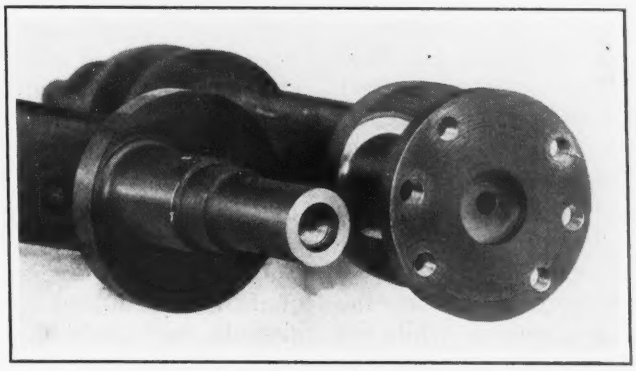


Fig. 1. Opposite Ends of Crankshafts Drilled, Reamed, Tapped, and Faced on Machine Shown in Fig. 2

The drilling heads are mounted on slides, which, in turn, are mounted on cast-iron ways cast on the machine bed. The heads are traversed back and forth by means of hydraulic cylinders located beneath the head slides. The right-hand head consists of one large cluster box with three six-spindle and one two-spindle special type drill heads mounted on the front side. These drill heads can be easily detached to permit changes in the operations. The left-hand head consists of one large cluster box carrying three nose-adjusting spindles.

The tapping heads are controlled by a reversing motor-driven unit. The right-hand head is equipped with four spindles, and the left-hand head with one spindle. The six-position, automatic, mechanically indexed, trunnion type fixture, arranged to hold one

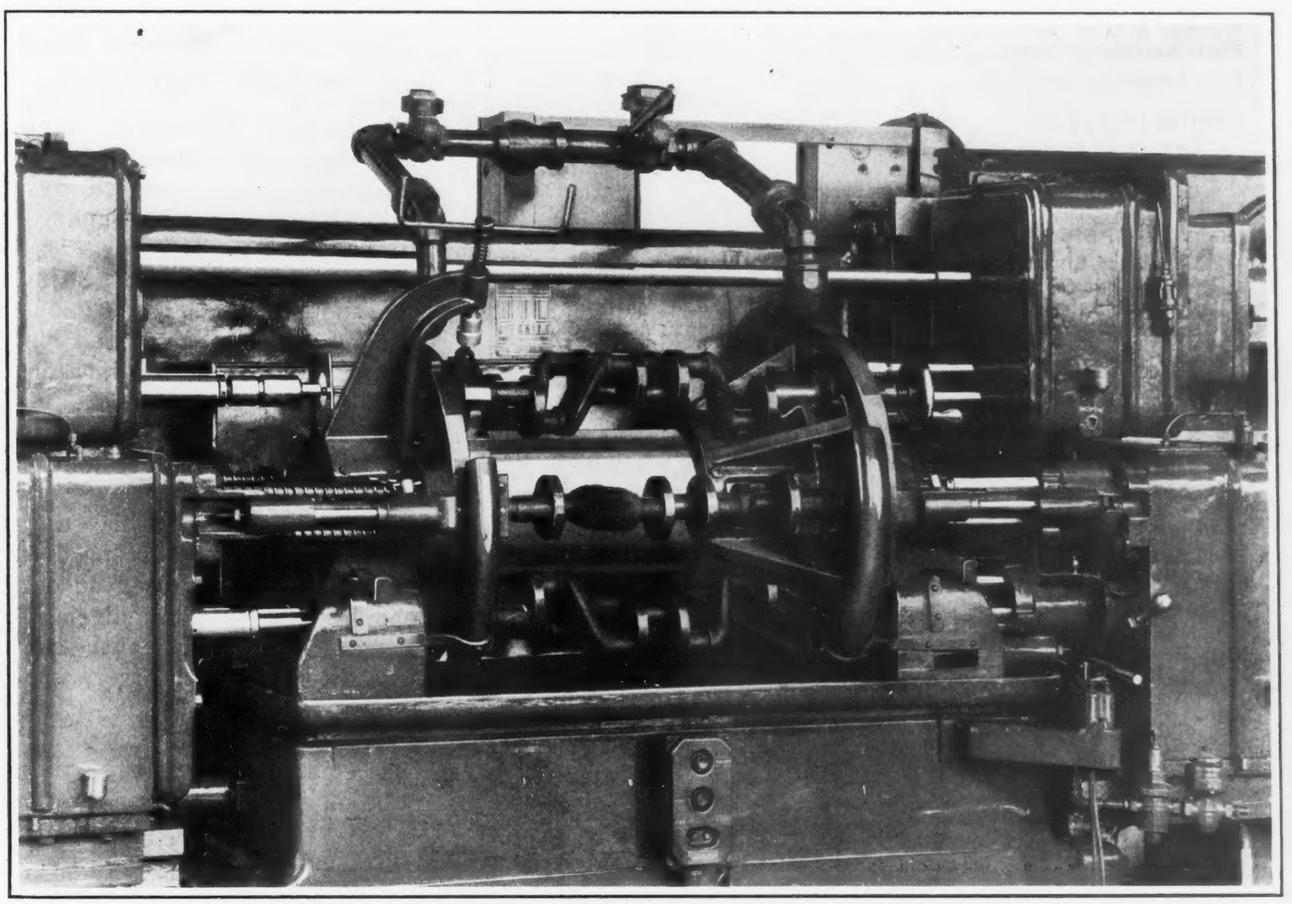


Fig. 2. Two-way Hydraulic Driller and Lead-screw Tapper Equipped with Six-position Fixture for Operations on Crankshafts

part in each position, is mounted in roller bearings. One piece is unloaded from the fixture and replaced by a new piece in the first or loading position. In the second position, the left-hand head drills one 9/16-inch hole to the required depth, while the right-hand head drills four 0.368-inch holes and one 27/64-inch hole and at the same time, reams one 13/32-inch hole.

In the third position, the left-hand head faces the 1 1/4-inch diameter end of the crankshaft, while the right-hand head reams the four 0.368-inch holes and rough-reams two other holes. In the fourth position, the left-hand head countersinks the 9/16-inch hole to a diameter of 13/16 inch with a 60-degree angle, while the right-hand head countersinks six holes.

In the fifth position, the left-hand head reams the 9/16-inch hole to 0.570 inch in diameter, while the right-hand head finish-reams two holes within the size limits of 0.436 and 0.437 inch. In the sixth position, the left-hand head taps one hole with a 5/8 by 18 tap, while the right-hand tapping head taps four holes with a 7/16 by 20 tap.

Forms for Recording Spring Manufacturing Data

By W. S. BROWN

The specifications required for the manufacture of compression springs are usually of such a nature that the requirements can be readily understood without the aid of a drawing or sketch. The provision of standard forms, such as shown in the accompanying illustration, saves the draftsman much needless work, as in most cases it is only necessary to fill in the required data in the spaces provided. The forms are made the same size as the smallest standard drawing sheets, and are printed on tracing cloth, or they may be typed when only a small quantity is required. These forms are durable and provide, with little effort, an orderly, uniform record of all spring details.

When tension springs are specified, they usually require a sketch showing the type of ends desired, and occasionally this is necessary in the case of compression springs. For such cases, a space is provided for the sketch at the bottom of the sheet. A section for noting any occasional excess loading is provided, so that there can be no misunderstanding regarding the service the spring is expected to withstand.

Material..
Diameter of Wire.......................................inches
Inside Diameter of Coils...............................inches
Outside Diameter of Coils..............................inches
Spring Works on Rod...........................inches diameter
Spring Works on Hole..........................inches diameter
Number of Free Coils....................................
Total Number of Coils...................................
Free Length*...inches

SPRING IN PLACE

Length of Spring in Place..............................inches
Load on Spring in Place*...............................pounds
Deflection of Spring in Place*.........................inches

NORMAL OPERATING CONDITIONS

Length of Spring under Normal Maximum Load......inches
Normal Maximum Load and How Applied*..........pounds...
Deflection at Normal Maximum Load*..............inches
Stress at Normal Maximum Load*...pounds per square inch

OCCASIONAL EXCESS LOADING CONDITION (IF ANY, CROSS THROUGH IF NONE)

Length of Spring Under Excess Load...............inches
Occasional Excess Load and How Applied*..........pounds...
Deflection at Excess Load*..........................inches
Stress at Excess Load*.............pounds per square inch

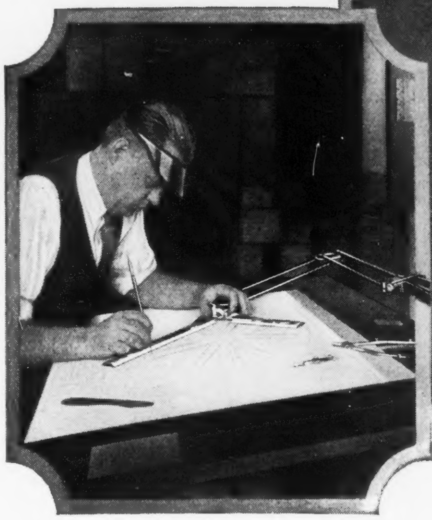
Load per 1" Deflection (Rating)*.......................pounds
Ends Finished...
Spring Wound...hand
Modulus of Torsional Elasticity..............................

Note: Items marked * are calculated and commercial tolerances are permitted. If the spring is to have ends of special shape or is for use in tension, show sketch below.

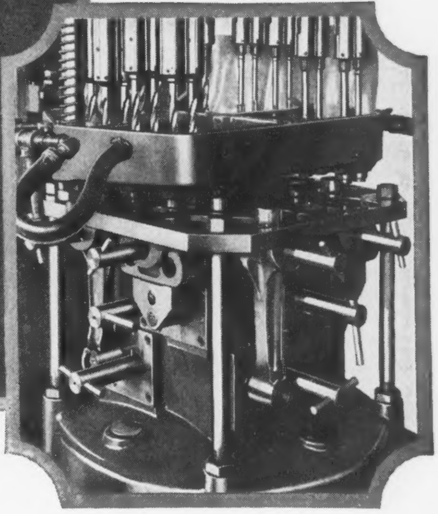
* * *

High-Speed Precision Shear for Cold-Strip Metal

An unusual high-speed precision flying shear for light-gage cold-strip metal has been developed by the United Engineering & Foundry Co., Pittsburgh, Pa. The shear is designed to handle strip up to 36 inches wide and from 0.006 to 0.025 inch thick, cutting any required length from 12 to 26 inches by increments of 1/64 inch, and from 26 to 52 inches by increments of 1/32 inch. The action is continuous and fully automatic, and the shear operates at a maximum speed of 300 feet per minute, a much higher speed than has previously been used on equipment for this type of material. In order to obtain each length exactly as required without error, it was necessary to design a gear-box having a total of 832 changes of speed. These changes are quickly obtained by the movement of three levers. It takes approximately eighty seconds to make any gear change, and not more than twenty seconds to change the guides. The setting of the knives can be changed while operating.



Design of Tools and Fixtures



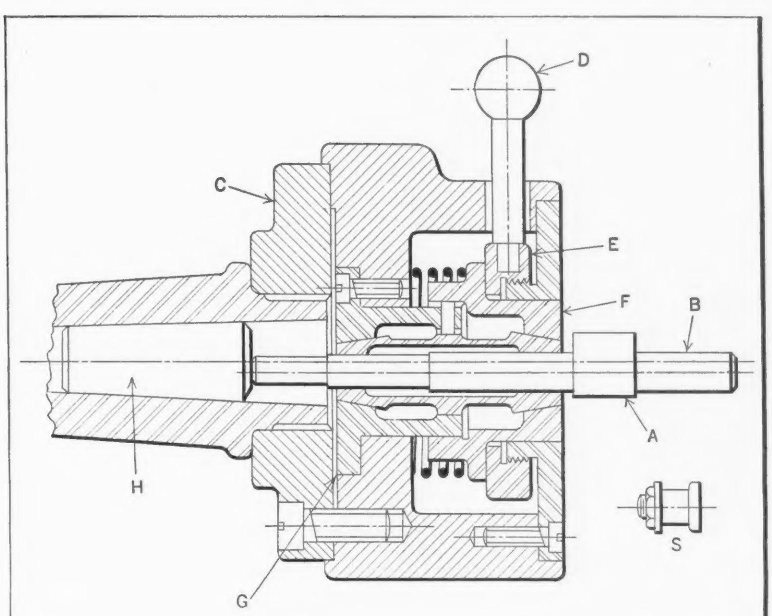
Dual Clamping Collet Chuck for Precision Work

By A. L. HARTLEY, R. K. LeBlond Machine Tool Co. Cincinnati, Ohio

The precision collet chuck here illustrated is used for turning an eccentric *A* on the shaft *B*. The rear collet jaws serve a triple purpose, assuring accurate alignment of the work, preventing vibration due to the whipping of a long unsupported end, and helping to drive the part when heavy torque is produced by the cutting tool. If it is necessary to use the chuck for short parts that do not extend back to the rear jaws, these jaws can be plugged by a simple stud *S*. The front jaws can then be used in the conventional manner. The clamping arrangement is located off center relative to the lathe spindle for the work shown, but the mechanism is equally well suited for clamping concentric work.

The body of the chuck is made concentric with the lathe spindle to prevent vibration that would result from rotating an unbalanced chuck at high speed. The chuck is mounted on an adapter plate *C*, which fits the spindle nose of the lathe and is finished in position. The clamping mechanism is entirely enclosed to keep out all dirt and chips.

In operation, handle *D* actuates nut *E*, which moves the sliding collet bushing *F*. This unit forces the collet back into fixed collet bushing *G*, and at the same time, clamps the work and holds it against stop *H*. When nut *E* is released, the coil spring forces bushing *F* forward, releasing the work.



Collet Chuck with Two Sets of Clamping Jaws Operated Simultaneously by One Lever

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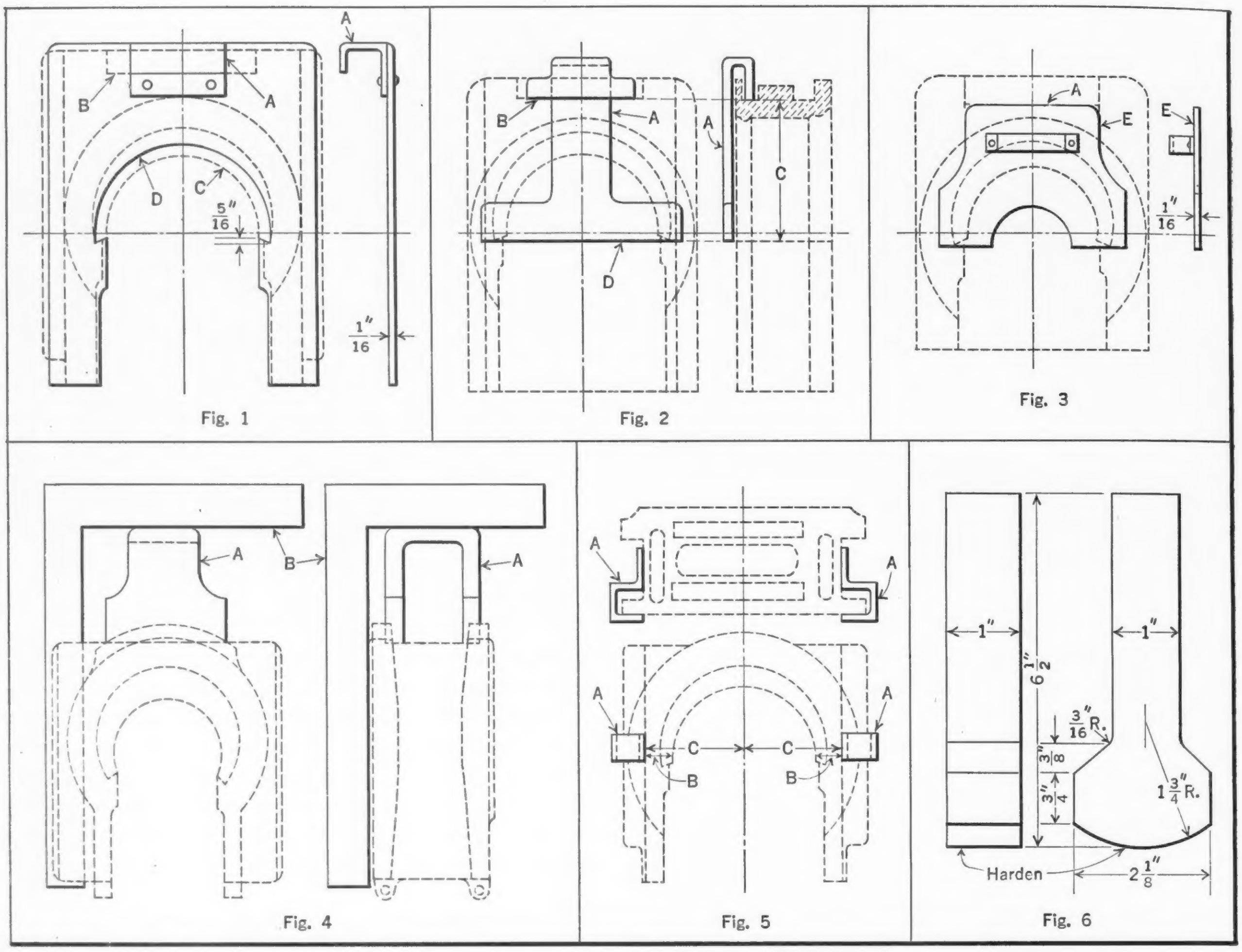
Gages and Burnishing Tool for Locomotive Driving-Box Maintenance

By H. H. HENSON, Foreman, Machine and Erecting Shops Southern Railway Co.

A set of gages and a burnishing tool that have been found very useful in restoring worn locomotive driving-boxes to the original blueprint dimensions are shown in the accompanying illustrations, Figs. 1 to 6. The gages are employed in laying out new bearings, as well as in maintenance work. The driving-box gage or templet seen in Fig. 1 is used in scribing or laying off the lines that locate the bronze bearing in the center of the driving-box, so that all boxes will be machined alike. The hook *A* rests in saddle pocket *B*



Figs. 1 to 5. Gages and Templets Used in Laying out Locomotive Driving-box Bearings and Restoring Worn Bearings to Original Dimensions. Fig. 6. Burnishing Tool for Smoothing Driving-box Bearings after Finish-boring Operation

while the circle *D* is being scribed or laid off in the driving-box for the bronze bearing *C*. It will be noted that the gage is shown in full lines, while the driving-box is outlined in dotted lines. The deep dovetail indicated by the 5/16-inch dimension has been found to give the proper angle for keeping the bronze bearing tight from one overhauling to the next.

The gage *A* shown in Fig. 2 is used in restoring the worn saddle seat *B* of the driving-box to the original blueprint dimension *C*. The worn surface *B* is built up with an electric arc welder until there is about 1/16 inch of excess metal. The excess metal is then melted off to give a bearing set at the correct distance *C* from line *D*.

The top edge of templet *E*, Fig. 3, is used in laying off a proof line on the side of the driving-box at *A*. This line indicates the depth to which the saddle seat should be milled, and also provides a means of setting the milling cutter for taking a cut of the correct depth.

The dummy spring saddle gage *A*, Fig. 4, is used for testing the squareness of the saddle seats in the driving-boxes. The two views show how the gage is used in connection with a carpenter's square *B* in testing the accuracy of the box saddle for squareness on both sides. Fig. 5 shows two handy driving-box center gages *A*, and indicates the method of using them to gage the center dimensions *B* and *C*.

A burnishing tool that has been used to advantage in obtaining a smooth finish in the driving-box bearings after they have been finish-bored is shown in Fig. 6. The use of this type of tool, however, is not recommended in some shops, although other shops employ it advantageously.

Automatic Indexing Die for Piercing Radial Holes

By EUGENE L. SOLTNER, Philadelphia, Pa.

Self-indexing dies find many uses in piercing a number of radial holes equally spaced around cylindrical shells. A rather unusual die of this type is described here. Its arrangement is such that two shells are pierced simultaneously. In order to obtain a smooth and quiet action, the indexing movement is imparted by a friction ratchet instead of a ratchet of the usual tooth and pawl design. A plan view of the lower die member is

shown in Fig. 1, and a sectional view through both upper and lower members in Fig. 2.

Two work mandrels *A* are held securely in the block *B* by the check-nuts *C*, and prevented from turning by the screws *D*, which engage slots in the flanges of the anvils. On each mandrel is mounted a friction ratchet consisting mainly of a ring gear *E* and a ratchet wheel *F*. Detail views of these parts, together with the friction rolls, are shown in Fig. 3. Wheels *F* are a running fit in block *B* and are retained in this block by pins *G*.

The rotary movement of the friction ratchet is imparted by the rack *H*, which is connected to the punch-block. This rack is a snug sliding fit in the block *B* to prevent any over-run of the ratchet. It will be noted in Fig. 2 that adjustment is provided for obtaining the correct ratchet movement and also for timing the indexing movement. This adjustment is obtained by moving the check-nuts *J* to the required positions.

On lever *K*, pivoted at *L*, Fig. 1, is the equalizing bar *M*. This bar, in turn, is pivoted at *N*, but its rotary movement is limited by the pins *O*. Two special rolls *P* are mounted on this bar and serve to hold the shells against the face of the wheels *F* while the holes are being pierced. These rolls also serve as a support for the work-holders to resist the thrust imparted by the piercing punches. The large ends of the shells have been notched in a previous operation, and advantage is taken of this notch to locate the shells on the holders. A lug *Q*, Fig. 2, provided on the ratchet wheel engages the notch, so that both wheel and shell will rotate together.

In loading the die, the operator slips two shells over the holders, making sure that the lugs *Q* engage the notches. Lever *K* is now swung inward, bringing the rolls in contact with the ends of the shells, so that they will have no endwise movement during the piercing operation. As the ram descends, a hole is pierced in each shell. Incidentally, the piercings from the holes are retained in the holders by the "trap door" arrangement *R* (Fig. 2) until the shells are removed. This is done to prevent the jamming of the piercings between the shell and the holder which might result in damage to the die, as well as to the shell. The spring pins in the punches also aid in this respect, as they keep the piercings from rising above the top edge of the holders. As soon as the shells are removed, the trap doors swing downward by gravity and allow the piercings to fall out.

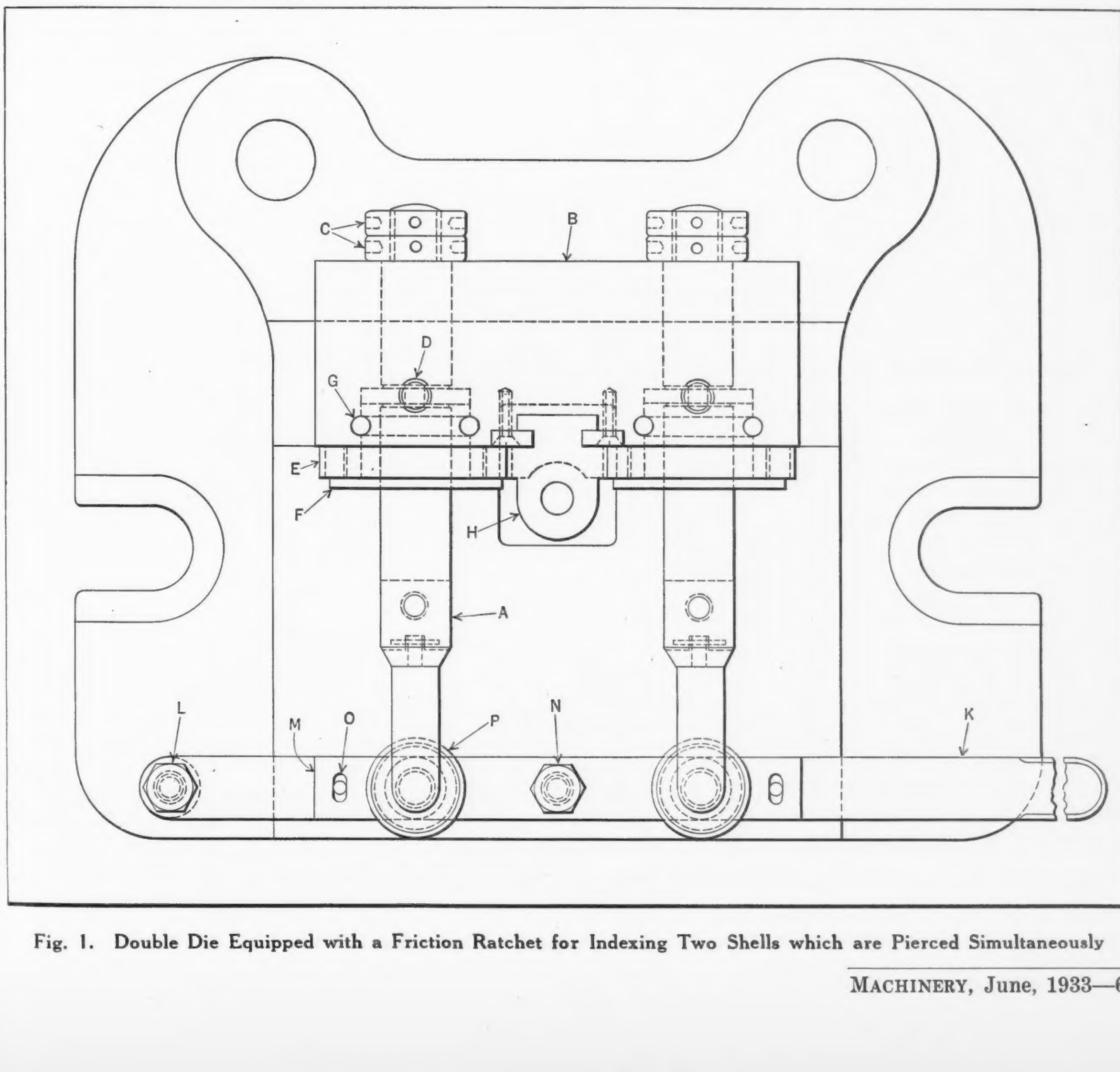


Fig. 1. Double Die Equipped with a Friction Ratchet for Indexing Two Shells which are Pierced Simultaneously

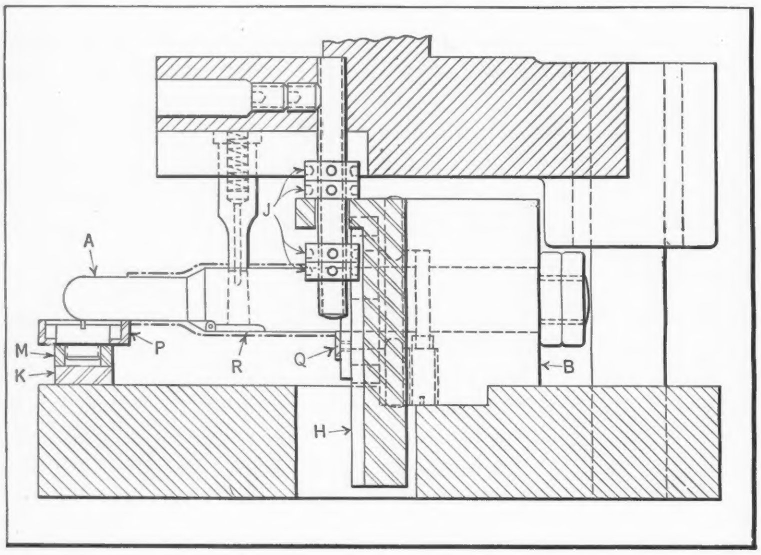


Fig. 2. Sectional View of the Die Showing How the Indexing Ratchet is Actuated by a Rack Attached to the Punch-block

After the first hole in each shell is pierced, the ram, in ascending, raises the rack *H*, causing the ratchet mechanisms to rotate the shells one-quarter revolution. On the succeeding downward stroke of the ram, the shells are held stationary while two more holes are pierced. Thus after the ram has completed four downward strokes, four equally spaced holes will be pierced in each shell. To remove the shells, lever *K* is swung outward.

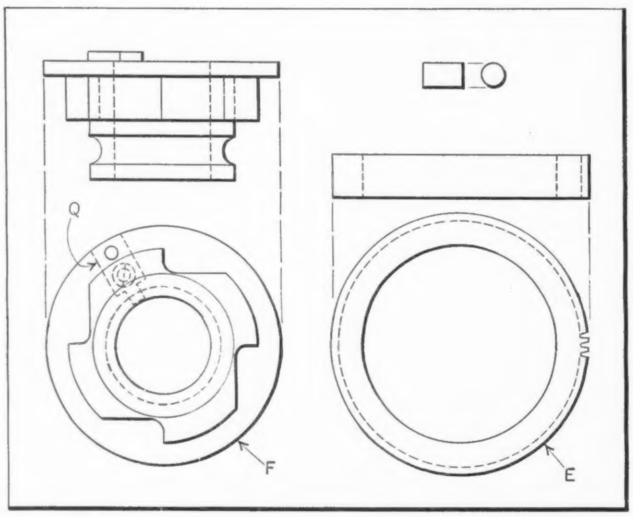


Fig. 3. Detailed Views of the Important Parts of the Friction Ratchet

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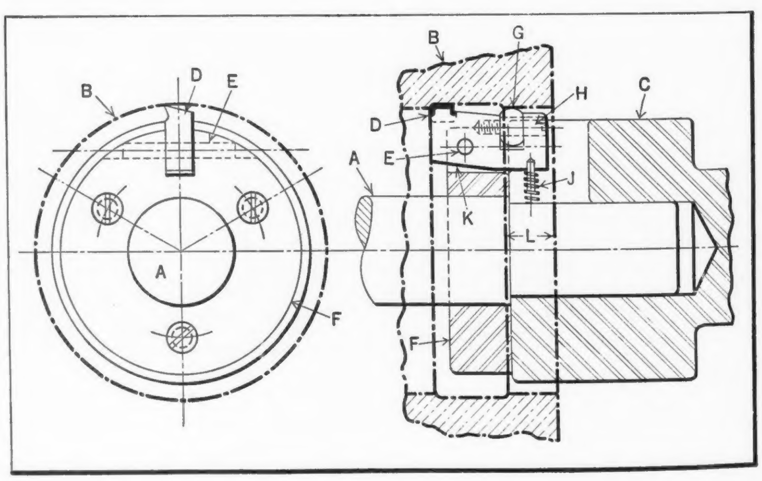
Special Tool for Boring Short Recess

A very effective recess-boring tool for use in the turret of a chucking machine is shown in the accompanying illustration. The bar *A* extends through the work *B* and is equipped with boring tools at the left (not shown in the illustration). These boring tools and the corresponding portion of the work were omitted, as the recessing part of the tool is the special feature to be described. The bar *A* of the tool is held in the shank *C*, and the recessing cutter *D* is pivoted at *E* in a slot cut through ring *F*. Mounted at the rear end of cutter *D* is a roll *G*, which is free to revolve on stud *H*. When the recessing cutter is moved back clear of the work, the spring *J* causes the cutter to pivot about pin *E* until the beveled seat at *K* comes in contact with the bottom of the slot in the retaining ring.



Recessing Tool which Operates Automatically when Tool is Fed Forward

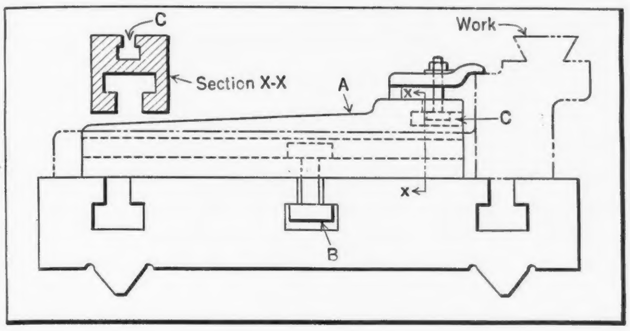
When the tool is fed forward, the boring cutters (not shown) bore the hole to the required size. Cutter *D* is held clear of the bored hole in the work until it has entered the hole a distance *L*. At this point, roll *G* comes into contact with the bored hole, causing cutter *D* to pivot about its center and thereby forcing the cutter into the work. The recessing cut is continued just as long as the roll is in contact with the bored hole. The space between the roll and the cutting portion of the tool, therefore, determines the length of the recess. F. H. M.

* * *

The extent to which the X-ray is being used for industrial purposes is perhaps best exemplified by reference to a laboratory that has been equipped to meet the needs for efficient inspection service. This laboratory has a railroad siding within fifty feet of its X-raying room; and should the work be too large to enable it to be removed conveniently to the X-ray apparatus, the latter can be taken to the freight car. Equipment is available by means of which it is possible to look through steel up to 3 1/2 inches thick, and through aluminum and other light weight metals up to 8 inches thick.

Ideas for the Shop and Drafting-Room

Time- and Labor-Saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



T-slot Bar for a Planer, which Locates the Clamping Bolt Close to the Work, Regardless of the Location of the Table Slots

Auxiliary Bar for Locating T-Bolts Close to Work on the Planer

A rather handy addition to any set of planer tools is the extension bar *A* shown in the illustration. It is used to permit the clamping bolt to be located very close to the work, regardless of the location of the table slots. The lower part of this bar has a T-slot in it, which is a loose fit for the upper end of the stud *B*. This stud is made from solid stock and its lower end engages the planer slot. An auxiliary T-slot is provided at the top of the bar for the strap bolt, as indicated at *C*.

This bar can be quickly moved into any position to bring the strap bolt close to the work. Obviously, a greater clamping pressure is produced with this arrangement than could be obtained by using a long and relatively slender strap with its T-bolt in the slot occupied by stud *B*.

Belleville, N. J. J. E. FENNO

Vise Fixture for Use in Cutting off Small Rivets

Probably every mechanic who has done model work or light jobbing of a similar nature has had difficulty in holding small rivets and screws without marring the heads while shortening the body. This difficulty may be overcome in a simple way as follows:

An 8-inch strap hinge of the flat type, that is, free from reinforcing ribs, is cut off on the pin side of the center screw-holes, and a row of holes of various sizes to suit the small rivets or screws most commonly used is drilled near the cut edge of one wing. On the inside of the other wing, opposite the row of holes when the hinge is folded, is riveted a strip of hard fiber about 1/8 inch thick.

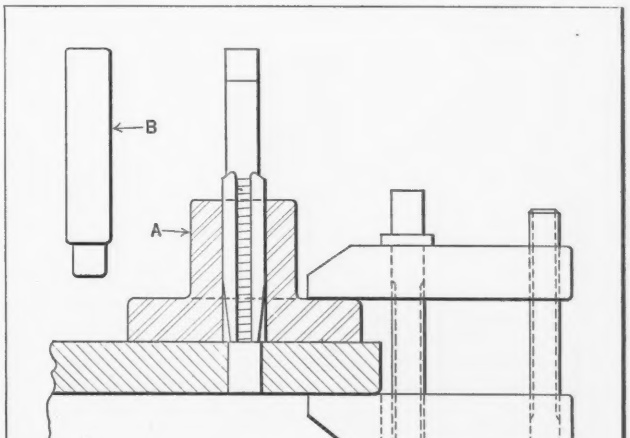
In use, the screw or rivet to be shortened is slipped into a suitable hole from the inside, the fiber strip closed against the head, and the hinge gripped in a vise. This fixture will hold the work sufficiently tight to permit cutting with a fine-toothed hacksaw.

Ontario, Calif. H. R. HAGEMAN

Simple Guide for Holding Hand Tap Square with Work

In hand-tapping holes for long bolts to be used in fastening parts together, it is essential that the tap be held square with the joining surface. This can be done by means of the simple equipment here illustrated. It consists merely of the guide bushing *A* and the aligning plug *B*. The hole in the bushing is bored to the body size of the tap, and the flange permits the bushing to be clamped to the part that is to be tapped. The plug has two diameters; the smaller one equals the diameter of the tap drill and the larger one the outside diameter of the tap. The small end of the plug is inserted in the hole to be tapped and the guide bushing slipped over the larger end. The bushing is then clamped securely to the work and the plug removed to allow the hole to be tapped. The bushing is hardened to resist the cutting action of the tap.

Meriden, Conn. PETER L. BUDWITZ



Guide Bushing for Hand Tap. The Plug B Provides a Rapid Means of Aligning Bushing with Tap-drill Hole

Five Hundred Operations Cost Less than Nineteen Cents

Fourteen Especially Equipped Machines Operated by Five Men Perform the Drilling and Tapping Operations on Lycoming Straight-Eight Cylinder Blocks at the Rate of 15 Blocks an Hour

OVER 500 operations, including the drilling, reaming, countersinking, and tapping of holes ranging in size from 1/8 to 1 1/2 inches in diameter, are performed on Lycoming straight-eight cylinder blocks of the type shown by the diagrams at the top of the accompanying table. A battery of fourteen especially equipped machines made by the Baush Machine Tool Co., Springfield, Mass., is employed for this work. The machines are operated by five men at a unit cost of 18.3 cents per block. The production is fifteen blocks per hour. By employing eleven operators, the production could be stepped up to forty-five blocks per hour with the same equipment, at a unit cost of 13.4 cents per block. The principal operations performed by each of the fourteen machines are listed in the accompanying table in consecutive order.

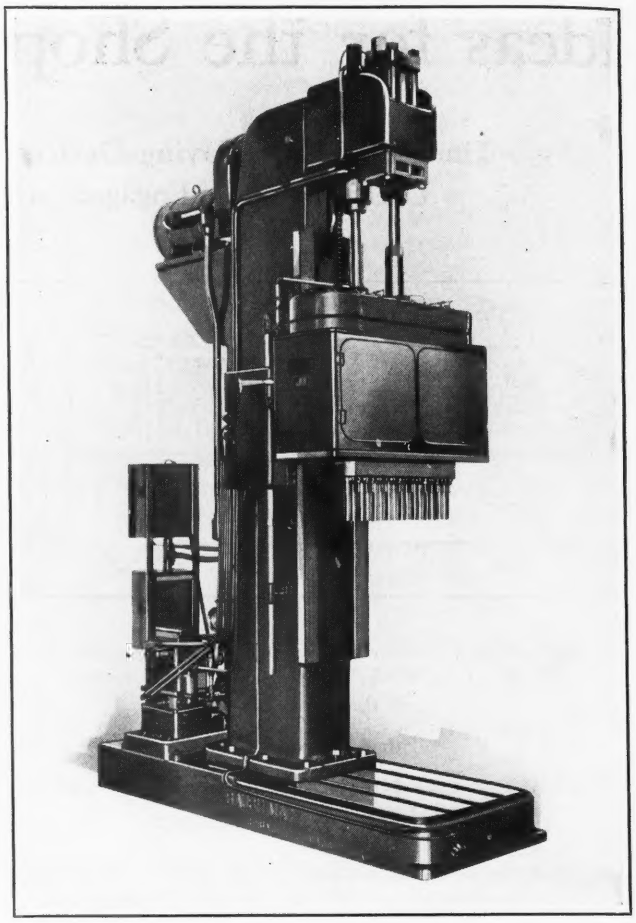


Fig. 1. One of Five Similar Machines Equipped for Drilling, Boring, and Reaming Operations on Cylinder Blocks

The first machine of the battery is equipped with a two-spindle head for drilling, reaming, and countersinking two 3/4-inch locating holes, one at each end of the face *B*, shown by the diagram at the right in the table.

The succeeding five machines—Nos. 2 to 6—which perform the operations outlined in the table, are like the one shown in Fig. 1. These machines have Oilgear feeds and straight-line multiple-spindle heads. Machine No. 2 has eight 2-inch spindles, while machines 3 to 6 have sixteen 1 1/2-inch-diameter spindles.

The seventh machine, shown in Fig. 2, is a three-way Oilgear feed type with a Baush unit having an eight-spindle head located at the rear of the machine. The drilling is done from four sides simultaneously. The left-hand horizontal head is 16 by 24 inches, and has thirteen spindles; the vertical head is 20 by 37

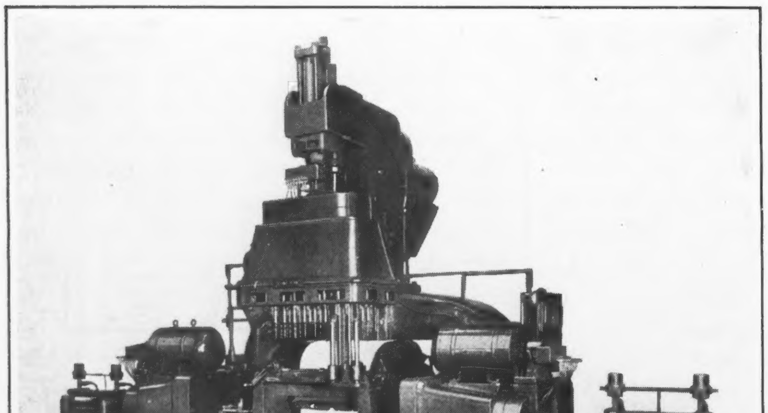
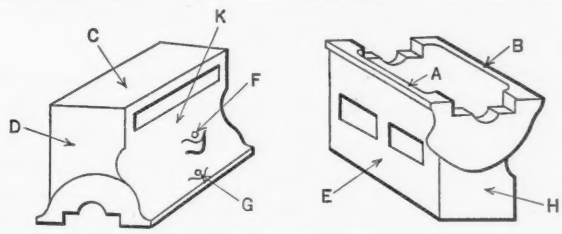


Fig. 2. Baush Three-way Oilgear Feed Drilling Machine Equipped for Drilling Holes in Four Sides of Cylinder Block Simultaneously

Table Showing Operations Performed Consecutively on Straight-Eight Cylinder Block by Fourteen Machines



1	2	3	4	5	6	7
Drill, ream, and countersink two ¾-inch locating holes at the ends of face *B*	Spot-face angular-valve top face at front of surface *C*. Spot-face 8 valve faces, then move block to right and spot-face 8 more	Rough-bore and spot-drill 16 valve holes at front of top *C*	Drill 16 valve holes at front of top *C*	End-ream and finish 16 valve and throat holes at front of top *C*	Size-ream 16 valve stem holes at front of top *C*	Drill 30 holes in top *C*, 8 holes in manifold side *E*, 13 holes in end *D*, and 17 holes in end *H*, simultaneously
8	**9**	**10**	**11**	**12**	**13**	**14**
Drill 19 holes in top *C*, 28 holes in side *E*, and 36 holes in side *K*, at one time	Counterbore 27 holes in top *C*, drill and ream holes *F* and *G* at angle of 22 deg., and drill 8 holes at angle of 5 deg. in side *E*, simultaneously	Tap 29 holes in top *C*, 8 holes at 5-deg. angle in side *E*, 9 holes in end *D* and 15 holes in front end *H*, simultaneously	Drill 26 holes in bottom *A*, and 6 holes in side *E*, simultaneously	Drill 33 holes in bottom *B* and 5 holes at 45-deg. angle in side *E*	Tap 5 holes at angle of 45 deg. in side *E*	Tap 29 holes in bottom *B*, 22 holes in side *E*, and 36 holes in side *K*

inches and has thirty spindles; while the right-hand horizontal head is 16 by 24 inches and has seventeen spindles.

Machine No. 8 is similar to No. 7, but performs drilling operations on only three sides of the cylinder block. The vertical head has nineteen spindles, the left-hand horizontal head twenty-eight spindles, and the right-hand horizontal head thirty-six spindles.

The ninth machine, shown in Fig. 3, is a hand-fed driller equipped with a vertical head for counterboring twenty-seven holes in the top *C* of the cylinder block. A Baush unit on the left side of the machine drills and reams the two holes *F* and *G* at an angle of 22 degrees from the vertical. Another Baush unit on the right-hand side drills eight holes at an angle of 5 degrees.

The tenth machine, used for tapping holes in four sides of the cylinder block, is somewhat similar to the drilling machine shown in Fig. 2, except that the three multiple-spindle heads are equipped with lead-screw feeds to provide for tapping. The left-hand horizontal head has nine spindles, the vertical head twenty-nine, and the right-hand horizontal head fifteen. Four different sizes of threads are tapped by the right-hand head. The Baush unit taps eight 7/16–20 threads at a 5-degree angle on the manifold side *E* of the block.

Machine No. 11 has an Oilgear feed and is equipped with a vertical head that drills twenty-six holes ranging from 1/4 to 3/4 inch in diameter. This head is designed for drilling the bottom sur-

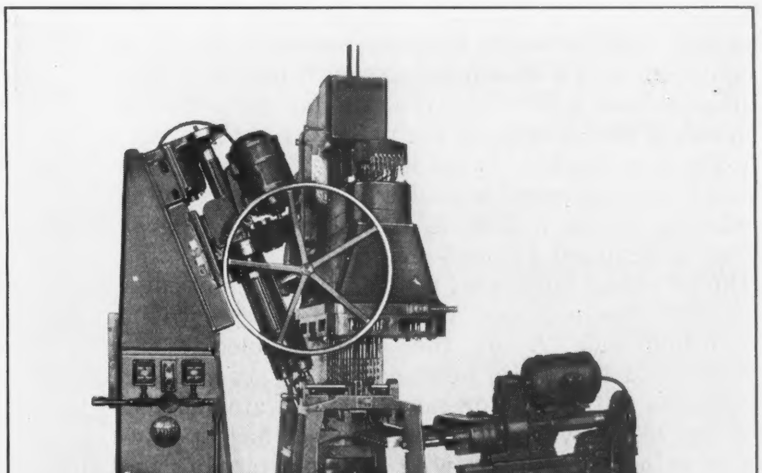


Fig. 3. Hand-feed Drilling Machine for Drilling Holes in Top of Cylinder Block and Two Sides, the Holes in the Sides being Drilled at Angles of 22 and 5 Degrees

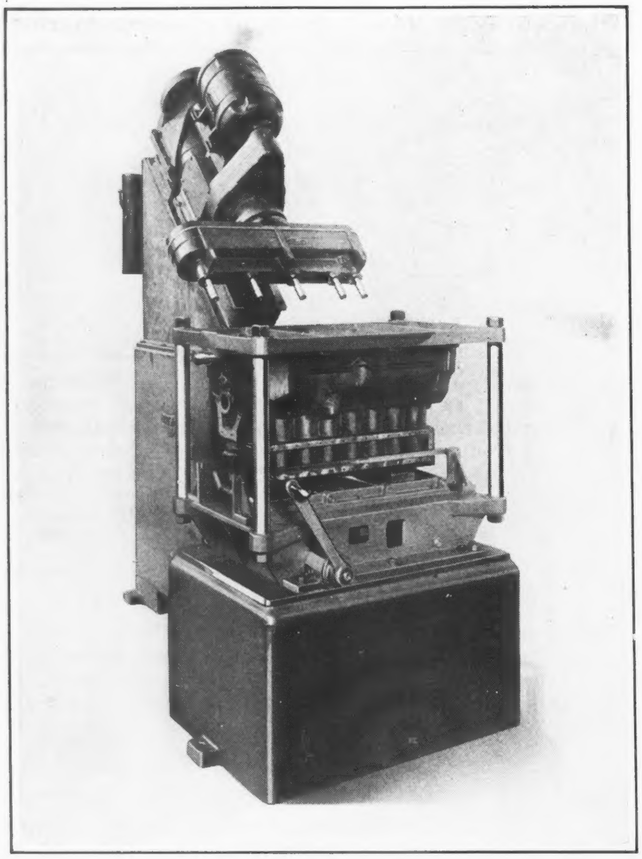


Fig. 4. Five-spindle Baush Tapping Machine Used in Tapping Angular Holes in Manifold Side of Cylinder Block

faces *A* and *B* of the cylinder block. The Baush unit drills six holes in the manifold side *E* of the block.

The twelfth machine is equipped with a vertical head having thirty-three spindles. The Baush unit on the left side of the machine drills five 21/64-inch holes in the manifold side *E* at an angle of 45 degrees. The thirteenth machine, shown in Fig. 4, is equipped with a Baush tapping unit having a five-spindle head which taps the angular holes drilled in side *E* of the block in the preceding operation.

The last machine in the line is a three-way lead-screw tapping machine similar in appearance to the machine shown in Fig. 2, except that the Oilgear feed is replaced by lead-screw feeds for tapping. The left-hand horizontal tapping head has twenty-two spindles equipped with taps for tapping the manifold side *E* of the cylinder block. The right-hand horizontal head has thirty-six spindles equipped with taps for tapping the water side *K* of the block, while the vertical head has twenty-nine spindles equipped with taps for tapping the bottom of the work.

* * *

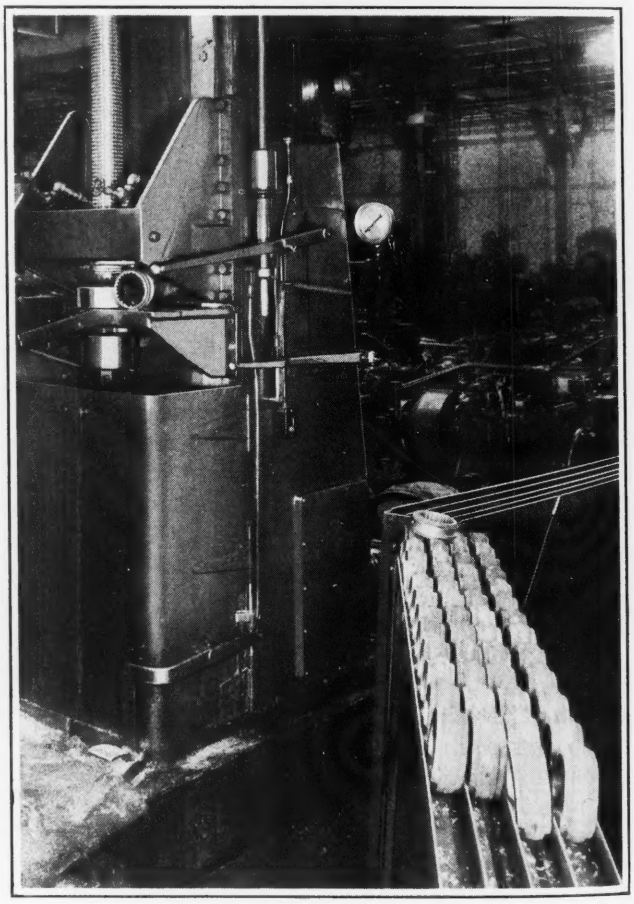
A good machine designer must know materials, as well as mechanisms. The selection of the right material is an art in itself.

Angle-Iron Provides Simple Conveyor System for Cylindrical Work

Angle-iron, assembled as shown in the accompanying illustration, provides a simple and efficient system for conveying small cylindrical work from one machine to another. Two angle-irons placed edge to edge form one complete guide, and eight angle-irons complete a four-guide system such as shown in the illustration. The amount of inclination of the guides required to effectively convey the work to and from each machine can be determined by experiment.

* * *

The man who knows the most about what devices and appliances are obtainable and best for certain purposes, their limitations, what efficiency may be expected from them, and their relation to the plant as a whole, will assemble the best plant and operate it to the best advantage. Inspection of the apparatus, and discussion with those that know all about it and are anxious to make this information known, get this information to one intimately. Expositions afford a splendid opportunity for such inspection and investigation.—*I. E. Moultrop.*



Cylindrical Work Rolls Down to this Machine on Inclined Guides Constructed of Angle-iron, and is Passed on for Succeeding Operations by Similar Guides

Questions and Answers

A Department in which the Readers of MACHINERY are Given an Opportunity to Exchange Information on Questions Pertaining to the Machine Industries

S. A. A.—Can any of the readers of MACHINERY give me information regarding the best method of removing the burr or roughness on one side of a gear after the hobbing operation has been performed? Have sand-blasting, scratch-brushing, or tumbling been found to be satisfactory methods of accomplishing this? The experience of others along these lines would be of value.

Answered by W. A. Rosenberger, Chief Engineer Pangborn Corporation, Hagerstown, Md.

Any of the methods mentioned above will, if applied sufficiently long, remove burrs. However, tumbling and sand-blasting in a blast-tumbling machine will damage sharp corners to a certain degree. This will be more pronounced the heavier the pieces are and the heavier the load is that is put into a barrel, whether it be a plain tumbling mill or a sand-blast barrel.

It is important, if this work is done by sand-blasting, that the pieces come to the blast in a dry condition, free from oil; and in order to do the least damage to the metal surface beyond the burrs, it probably will be necessary to use a fine steel shot rather than sand or angular steel grit.

If either tumbling or sand-blast tumbling is practical, the blast-tumbling operation will probably give from four to six times the production of an equal size ordinary tumbling mill.

Scratch-brushing would appear to be a rather laborious and slow process; but if the production requirements are low, it may be a practical solution.

Hardening of Threading Taps

G. M.—What methods are recommended for hardening both carbon-steel and high-speed steel threading taps?

Answered by Owen K. Parmiter, Metallurgical Engineer, Firth-Sterling Steel Co., McKeesport, Pa.

For carbon-steel threading taps, it is customary to use a steel containing about 1.15 per cent carbon. A vanadium content of up to 0.25 per cent is desirable, but not essential. The vanadium permits of a higher hardening heat, but the same temperatures as with straight carbon steels can be used. It is desirable, but not always necessary, to preheat the work to about 1200 degrees F. and then transfer it to a furnace heated to from 1425 to 1450 degrees F. Small sizes are heated on the low side of this range, and the larger ones at higher heats. The heating can be done in either a fused-salt bath or a controlled-atmosphere furnace. The quenching should be done in water or a brine solution held at a temperature in the vicinity of 70 degrees F. The hardened taps are drawn from 325 to 475 degrees F., depending upon the work they are required to do.

For high-speed steel threading taps, the standard "18-4-1" composition is generally used. Heating can be accomplished in a controlled-atmosphere furnace or in a fused-salt bath. The proper preheating range is from 1500 to 1550 degrees F. It is customary to use a high heat of from 2250 to 2300 degrees F. for taps, but a higher temperature can be applied if the furnace atmosphere is properly controlled. Quenching in warm oil is good practice. The usual drawing heat range is from 1050 to 1150 degrees F., depending upon the desired balance between hardness and toughness.

Cyanide Hardening

E. G. B.—The following questions pertaining to cyanide hardening are submitted to MACHINERY'S readers: (1) In hardening by the cyanide process, is it preferable to use straight cyanide of potassium, or are there other materials which, when added, would improve the depth of penetration and the degree of hardness? If so, in what proportions should these materials be used? (2) What is the method recommended for handling small articles, say, 1/4-inch set-screws, so that when they are withdrawn from the heating liquid and thrown in the water there will be no "explosion"? (3) What is the best material for the cyanide pots? Is heat-resisting steel recommended?

* * *

That the operation of plastic molding dies affords a good opportunity for time study by service engineers is illustrated by the case of a molder who was producing jar covers at the rate of 130 pieces a day. A stop-watch study of the loading and curing time made by a service engineer revealed that it was taking 7 1/2 minutes for each cycle. It was evident that the press platen was too high and that the arbor press was too far from the molding press for efficient handling of the molds. A platform was built in front of the presses and the distance between the arbor press and the molding press shortened. This change raised the production to 190 covers a day—a gain of about 45 per cent.

Design and Application of Elliptic Chucks

Chucks Adjustable to Various Elliptical Shapes Find Many Applications in Both Tool and Production Departments

By WARREN P. WILLETT

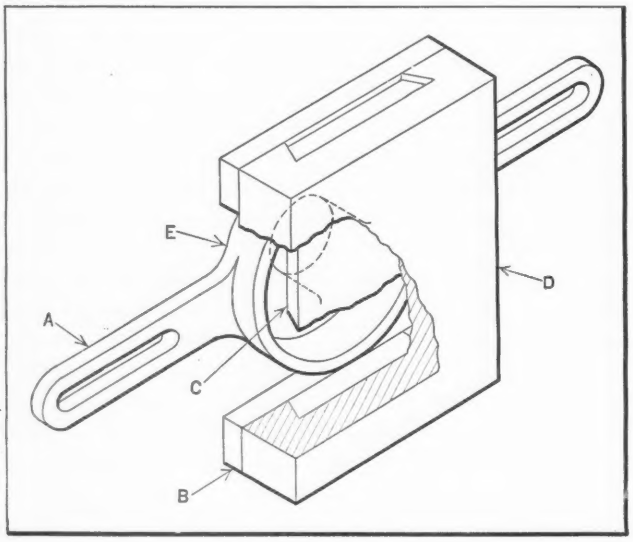


Fig. 1. One of the Earlier Elliptic Chucks which, although of Simple Design, was Difficult to Adjust

ELLIPTICAL shapes are employed far more in manufacturing plants than the average person realizes. For example, they are used in the manufacture of talcum-powder cans, picture frames, brush backs, mirrors, cuff buttons, and metal trays. For some of these articles, the ellipse is generated directly in the material, while in other cases, the part is stamped in dies having an elliptical shape. Thin sheet-metal parts are also frequently spun to shape about elliptical mandrels.

Various methods have been devised for generating ellipses, but the most practical of these is the use of the elliptic chuck. This is a self-contained unit, adaptable to lathes and boring mills, and it is flexible in application. With this method, elliptical turning becomes as simple as circular turning, although the chuck itself is slightly more intricate than the ordinary chuck.

The ellipse is produced by a combined circular motion and harmonic reciprocation. A compound rotary slide is employed to produce these two movements. The chucks made by various manufacturers differ somewhat, according to the work on which they are used, but the basic principle is the same in most cases.

Design of One of the First Elliptic Chucks

One of the first elliptic chucks ever made was of the simple form shown in Fig. 1. This chuck consisted of a rectangular block *D* with dovetail ways, into which was fitted the driving member *C*, which was screwed on the lathe spindle. A shoe *B* was bolted to each end of block *D*, and the eccentric *E* worked directly between these shoes. The eccentric was bolted to the lathe headstock through the slotted arms *A*, which allowed sidewise adjustment to suit the offset required. This chuck was quite satisfactory for light service, though somewhat crude and awkward to adjust.

Types of Chucks in General Use

The sturdiest types of elliptic chucks, and the ones most generally used, are shown in Figs. 2 and 3. These two designs are practically the same, except that in the one illustrated in Fig. 2, the faceplate *P* has a reciprocating motion, while in the one shown in Fig. 3, the work-holding slide *S* reciprocates. The type shown in Fig. 2 is designed for heavy duty and is generally used for metal turning. The work can be bolted to the faceplate by means

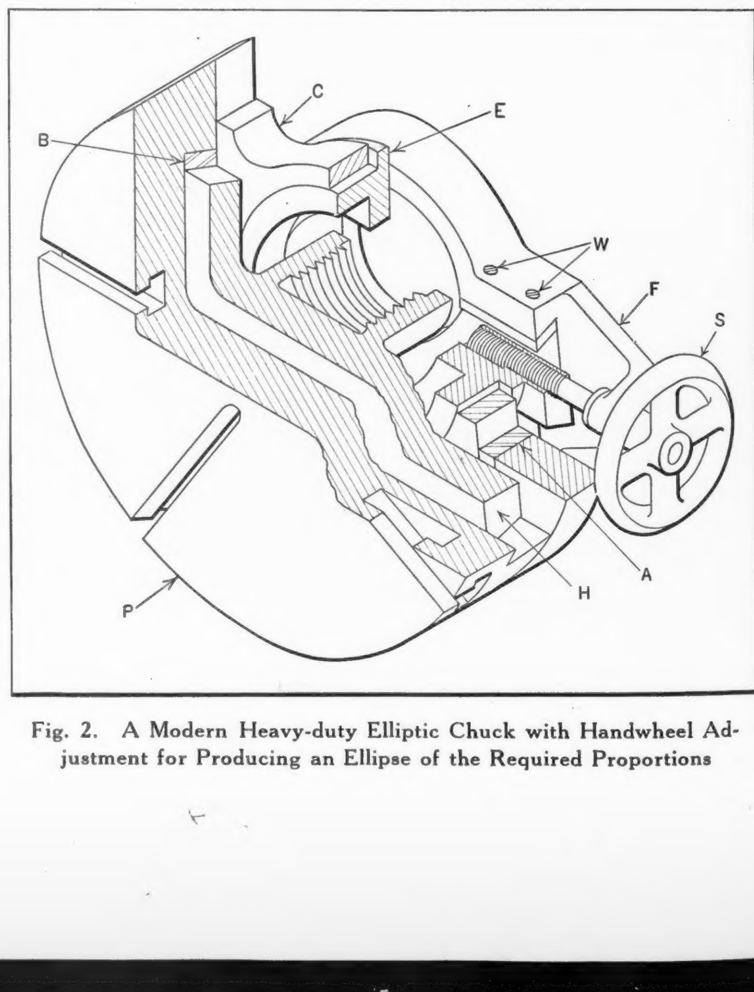


Fig. 2. A Modern Heavy-duty Elliptic Chuck with Handwheel Adjustment for Producing an Ellipse of the Required Proportions

of the radial T-slots or a jaw chuck can be substituted for the faceplate, if desired. The type shown in Fig. 3 is intended for lighter service and higher speeds. This style is extensively used in the metal-spinning industry. When used for this purpose, the work is done on a mandrel which is attached to the slide *S*.

Referring again to Fig. 2, it will be seen that the faceplate *P* is supported by, and slides on, the dovetailed driving member *H*, which is threaded to fit the lathe spindle. The sliding movement is imparted to the faceplate by the cross-head *C*. The cross-head is a running fit on the eccentric ring *E* and slides in the transverse ways at the back of the faceplate.

The eccentric is normally stationary, but is fitted to the adjusting bracket *F* by dovetail ways, so that it can be adjusted radially by means of the handwheel *S*. The adjusting bracket is securely bolted to the lathe headstock. The range of adjustment of the eccentric is from a central position up to the limit of its capacity, which may be several inches.

In adjusting the chuck for operation, the eccentric ring is moved off center an amount equal to half the difference between the major and minor axes of the ellipse to be generated. The ring is then clamped in this position by tightening the gib screws *W*. After the chuck is adjusted in this way, the machining operations are substantially the same as in other turning or boring work.

In designing the chuck, it is, of course, essential that the proper amount of clearance be maintained between the sliding parts; for this purpose, adjustable gibs, as shown at *A* and *B*, are provided to compensate for wear. The cross-head is made in two parts, so that the wear between it and the eccentric ring can be compensated for.

High-Speed Chuck for Metal Spinning

A feature of the chuck shown in Fig. 3 is the rotatable adjusting bracket *F*. Instead of bolting this bracket permanently in place, as in Fig. 2, it is clamped to the lathe headstock by means of an annular T-slot, which provides for angular adjustment. This makes it possible to attach to the slide a formed mandrel for metal spinning and to adjust the eccentric ring *E* to the angular position that will cause the periphery of the mandrel to run true with the forming roller.

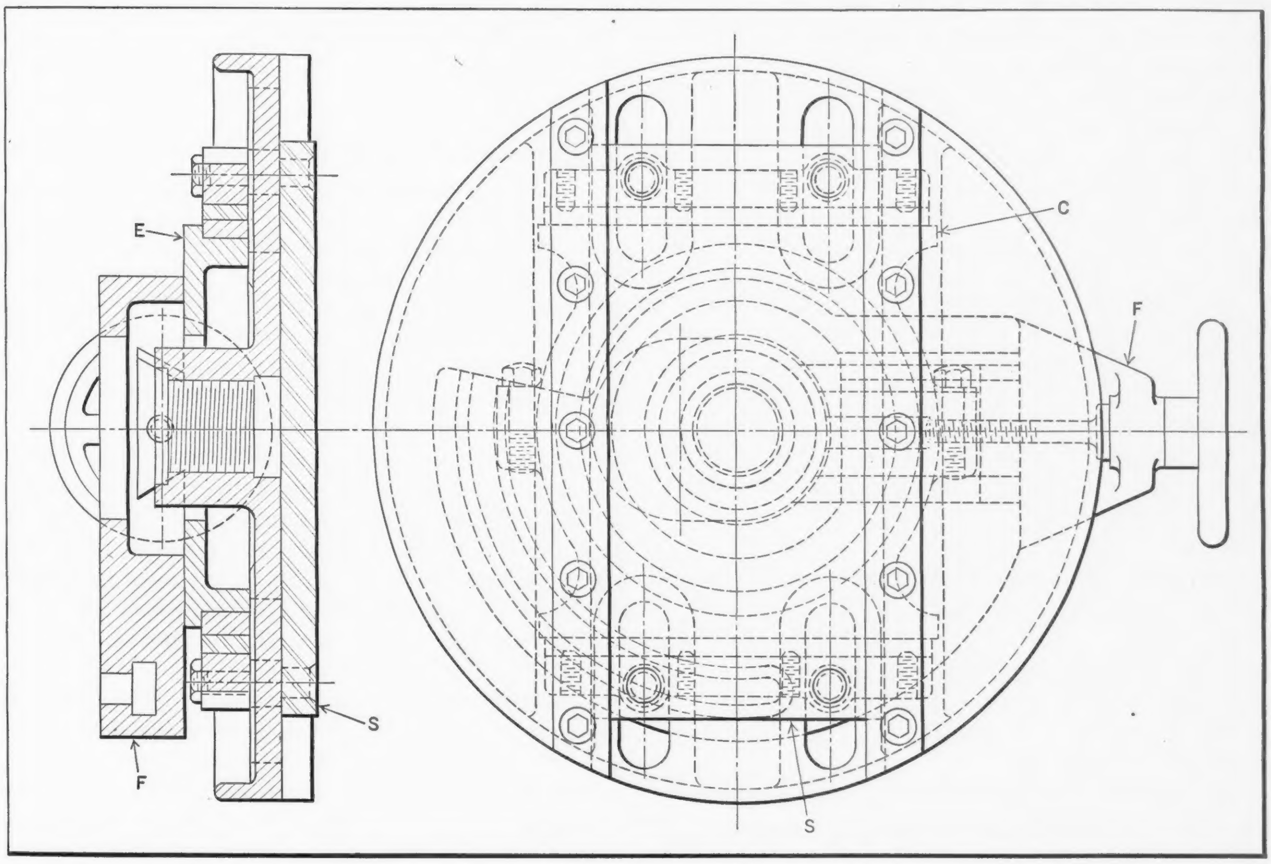


Fig. 3. Elliptic Chuck with Light-weight Work-slide which Permits Higher Operating Speeds

It will be noted that in this chuck adjustable gibs are provided on both sides of the cross-head *C* and slide *S*. This is done in order to hold the centers in alignment when adjustments are made for wear. The eccentric ring is shown set in its neutral, or central, position. In this position the chuck would, of course, have only circular motion. Chucks of this type are used largely for metal spinning because of the higher speeds required in this class of work. By imparting the reciprocating motion to

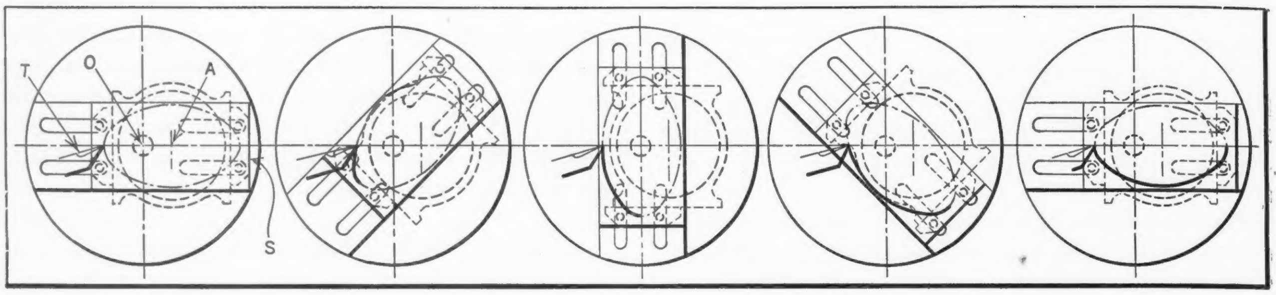


Fig. 4. Diagrams Illustrating Action of Elliptic Chuck Shown in Fig. 3

the relatively light slide instead of to the heavier faceplate, as is done with the design shown in Fig. 2, the chuck can be run at higher speeds without dynamic unbalance.

The diagrams in Fig. 4 show the elliptic chuck just described in action. The heavy black curve, which represents the progressive development of the ellipse, is traced for the first half of the operating cycle only, the second half being identical with the first. The point of the tool *T* must be set exactly on a horizontal line passing through both centers at *A* and *O*; otherwise, an inaccurate ellipse will result. The matter of location of the tool point may be of small concern in some kinds of elliptic turning, but it is of vital importance in metal spinning, because this work is generally done on an elliptical-shaped mandrel, which is bolted in place on the chuck slide *S* and must run true with the forming roller.

For Extra High Speeds, the Planetary Chuck is Better Balanced

Another form of elliptic chuck, which permits of still higher speeds, is shown diagrammatically in Fig. 5. Epicyclic gearing is employed here and the harmonic motion is imparted to the slide *S* by the crankpin *P* fixed to the gear *A*. Gear *A* has its shaft fixed to the faceplate and it rolls about the stationary gear *B* as the faceplate rotates.

Gear *C*, which is similar to gear *A*, is used to move another slide at the rear of the faceplate. The second slide, actuated by another crank, is always moving in the opposite direction to slide *S*, and in this way, the weight of slide *S* is constantly being counterbalanced. No provision is made, however, for counterbalancing the work, which is attached to the slide, but this is not an important matter, because of the light work for which this chuck is used.

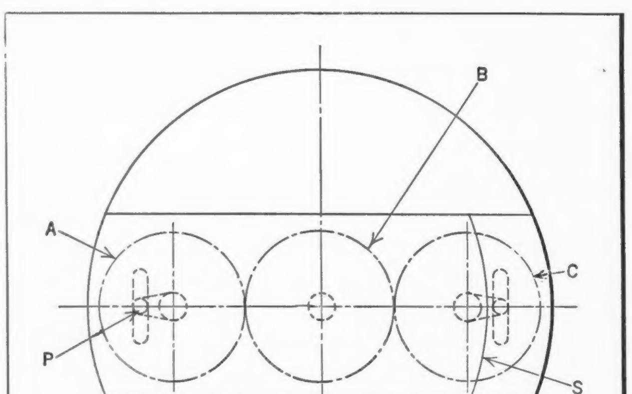


Fig. 5. Elliptic Chuck of Planetary Design Equipped with a Balancing Slide for Very High Operating Speeds

* * *

Stainless Steel Developments Featured at New York Exhibition

Progress in the development and application of stainless steels was recorded in a very impressive manner at a joint meeting of the Metropolitan Section of the American Society of Mechanical Engineers and the local sections of four other national engineering societies held at the Engineering Societies Building, New York City, April 26. A special feature of the meeting was an extensive exhibit of stainless-steel products presented in classified displays. The lobby of the Societies Building, resplendent with this display of stainless steel, was opened at noon to give all present an opportunity to observe the range of application and methods of processing, constructing, and fabricating this material.

The evening technical section, with George H. Charls, secretary, American Iron & Steel Institute, presiding, brought forth three interesting papers by leading authorities on the metallurgy of stainless steel: "Development of Stainless Steels and the Present State of the Art," by Marcus A. Grossman, research engineer, Illinois Steel Co.; "Heat Resisting Steels," by Frederick M. Becket, president, American Institute of Mining and Metallurgical Engineers, and president, Union Carbide & Carbon Research Laboratories, Inc.; and "Uses and Applications of Stainless Steels," by W. M. Mitchell, metallurgical engineer, U. S. Steel Corporation.

Reducing Tool Costs by Using Alloy Steels

By RUSSELL P. WHITE, Consulting Manufacturing Engineer, Chicago, Ill.

ONE plant has made a large saving by the intelligent use of alloy steels in its tool-room. This saving was secured without any investment of capital. Much has already been written about alloy steels and their application, and I do not expect to contribute any new information on that subject. My object is merely to tell how one factory used some of the information it had.

The plant referred to employed about 6000 workers during the peak production years. It manufactures an automotive product and maintains a separate department for the construction and repair of tools. This tool-room is under the supervision of a foreman, who, some five or six years ago, decided to see what he could accomplish in the way of reducing his bill for materials.

He realized that expensive steel was being used in many small applications—a pound for this tool, half a pound for that one, and maybe two or three pounds for another. It was, therefore, apparent that any large saving could be gained only as a result of many small economies. With this in mind, he tried using the less expensive alloy steels whenever it seemed possible to do so. The results were very gratifying, and during the last five or six years his tool-room has been using steadily increasing amounts of comparatively low priced alloy steels for purposes where it had formerly been believed that only high-priced steel would be satisfactory.

Properties of S A E 52100 Steel and How This Material is Used

During a two-year period, S A E 52100 steel was used for over 27 per cent of the applications where a more expensive steel would have ordinarily been employed. With suitable heat-treatment, S A E 52100 steel will develop practically the same hardness and strength as good tool steel, but more care is required in the heat-treatment to avoid brittleness. The high chromium content of this steel gives excellent penetration of the heat-treatment, but it also makes the steel rather sensitive.

It is essential that S A E 52100 steel be thoroughly normalized and annealed before machining, and at the plant referred to, stock was purchased annealed at the mill. No straightening should be done without subsequent annealing, and this steel must always be drawn after hardening. In any application where wear is not accompanied by shock or severe strain, and where hardness is the main factor and brittleness does not constitute a serious drawback, this steel is very serviceable. In border line applications, where the choice between tool steel and carburized and hardened mild steel is difficult, it is safe to say that S A E 52100 steel will be more satisfactory than mild steel at little additional cost. On applications where wear is accompanied by shock or severe strain, it is less certain that S A E 52100 steel will be entirely satisfactory.

Using Alloy Steels for Punches and Dies

When the service is severe, as for blanking dies, when there is only one part to be made, or when the cost of steel is slight in comparison with the cost of machining labor, the practice at this plant is to use high-grade tool steel, especially if it is probable that replacements will not be required frequently.

It has been found, however, that ordinary piercing punches made from S A E 52100 steel will perform fully as well as those made from higher priced steel. Investigation over a period of years indicates that when a punch breaks after a very few holes have been pierced, it is usually due to faulty heat-treatment or misalignment of the punch and die, or both, and it is just as likely to happen to tool-steel punches as to those made of the alloy steel.

The fact that this plant used a considerable number of punches enabled it to work out satisfactory heat-treatments and thus avoid depending on "luck," which is likely to be done when single dissimilar pieces are to be hardened. Probably the largest saving on any one application was on punches. The quantities involved were fairly large, machining labor was not high, and skill in heat-treatment was readily secured.

Piercing Jobs on which an Alloy-Steel Punch Proved Superior

An outstanding example of the successful use of S A E 52100 steel for punches and die buttons will be described. Two 11/16-inch holes on approximately 3-inch centers are pierced through S A E 1045 stock, 5/16 inch in thickness. These parts are formed on a radius of about two feet before being pierced, and this curvature tends to bend the punches. The service for punches was considered severe, due, in part, to the hardness of the stock pierced. Prior to the use of S A E 52100 steel for these punches, various grades and kinds of higher priced steels had been tried out. Punches made of S A E 52100 steel were tested and were found more satisfactory than the higher priced steel punches.

These tests were conducted by placing punches made from both the alloy steel and the higher priced steel together in the die and running them simultaneously. In one such test, after piercing approximately 60,000 holes, the alloy steel punch was in better condition than the one made of the higher priced steel.

Another application in which punches made from S A E 52100 steel were found very satisfactory was in the case of a number of large gang dies. Parts made from S A E 1010 stock, 1/4 inch thick, required from 100 to 200 pierced holes about 11/16 inch in diameter.

Heat-Treatment of Alloy Tool Steel

The heat-treatment for the punches is varied to suit individual cases, but in general, it may be said that after the annealed stock has been machined, the punches are heated to about 1450 degrees F. and soaked for a considerable time, say, about half an hour, for a furnace load of twenty 3/4-inch punches. They are then quenched in water and drawn at about 350 degrees F. to a hardness of approximately 80 scleroscope.

In addition to its use for punches, this steel has proved satisfactory in the following applications: Drill bushings, lathe centers, mandrels and arbors, rivet sets, plug gages, light coining dies, and facings for bulldozer forming dies. It is also adapted for miscellaneous hardened parts on jigs and fixtures, such as V-blocks, rest buttons, gage-blocks, locating pins, guides, and bearing plates, and for miscellaneous hardened machine repair parts, such as cams, cam followers, rollers, shafts, thrust washers, and ratchets.

It has been found convenient to keep a supply of this steel on hand in the tool-room. Rounds from 7/8 inch to 1 1/8 inches by 1/8-inch steps, and from 1 1/4 to 3 inches by 1/4-inch steps are kept in stock. The maximum demand seems to be for the 7/8- and 1-inch sizes.

S A E 3140 Nickel-Chromium Steel Proves Useful when Strength is an Important Factor

Records do not show the exact amount of S A E 3140 steel used at this plant for "non-productive" purposes. This is due to the fact that steel of this analysis is also used in the product. In addition, a large quantity of steel is salvaged from short bar ends and scrapped parts. Very little of this steel needs to be purchased especially for the tool-room.

Nickel-chromium steel S A E 3140 will not develop so much hardness as S A E 52100, but will show greater strength. This makes it a good steel for use when shock is a factor and when extreme hardness is not essential. In view of the fact that the cost of S A E 3140 steel is but slightly greater than that of ordinary machine steel, it is widely used in this tool-room to improve quality and increase serviceability. For any hardened part, the slightly higher cost of the steel is somewhat offset by the fact that it is not necessary to carburize S A E 3140 steel. Observation at this plant shows that there has been a reduction in the number of replacements required, due to the use of this steel.

Shearing S A E 1045 Steel with Blades of S A E 3140 Steel

S A E 3140 steel has been successfully used for shear blades on one application that merits description. Parts are sheared from a special rolled section of S A E 1045 steel. This special section is in the shape of a capital "A". The point of the "A" is closed for 3/4 inch. The walls and feet vary from 1/4 to 3/8 inch in thickness, and the distance from the top to the bottom is about 6 inches. The distance across the feet of the "A" measures about 4 1/2 inches. The stock is ordinarily in a semi-hardened state when sheared.

Many steels were tried out on this job, some of them costing as much as $1.40 per pound. When the stock to be sheared was near the high limit of hardness, there was considerable breakage of the shear blades, and it was found that blades made of S A E 52100 steel also broke on hard stock. In the event that breakage did not occur, it was sometimes possible to shear between 75,000 and 85,000 pieces with a set of blades made of either tool steel or S A E 52100 steel; and it was further found that breakage was minimized when the shear blades were drawn down to a hardness of between 60 and 65 scleroscope.

In view of the relatively low hardness requirement, it was decided to try S A E 3140 steel, and for more than three years shear blades made from this steel have been performing satisfactorily on this job. Breakage due to hard stock and faulty heat-treatment has been practically eliminated.

On an average, probably not more than 50,000 pieces are sheared with a single set of blades; but in view of the decrease in breakage, it is certain that the number of pieces sheared for each set of blades made up has increased considerably. Most of the stock for these shear blades is forged to rough dimensions, and in this way a large amount of steel is salvaged from short bar ends and scrapped production parts. No steel is purchased especially for these blades, and this means that the cost of the steel utilized for them has been reduced materially. A set of shear blades weighs over 55 pounds, so that the saving is worth while. In fact, this single application is saving more than $1000 yearly.

In addition to its use in shear blades, S A E 3140 steel has been satisfactorily used for parts like studs, bolts, nuts, set-screws, wrenches, nut sets, drop-hammer keys, miscellaneous jig and fixture parts such as clamps, miscellaneous machine repair parts of all kinds, stud drivers, milling machine arbors, boring-bars, tool-blocks, cutter bodies, reamer shanks, and wedges.

In conclusion, it should be said that indiscriminate use of these alloy steels is not advocated. Any attempt to use S A E 52100 steel without a proper

realization of the care that must be taken to give it suitable heat-treatment will probably be unsuccessful. The nickel-chromium steel S A E 3140 can be used with greater freedom and in almost any service where hardness in excess of 65 scleroscope is not required.

Out of the vast number of alloy steels that are available, only a few of the uses found for two of them have been indicated. The limited use described has produced savings and shows what can be expected if a thorough study is made of the subject.

* * *

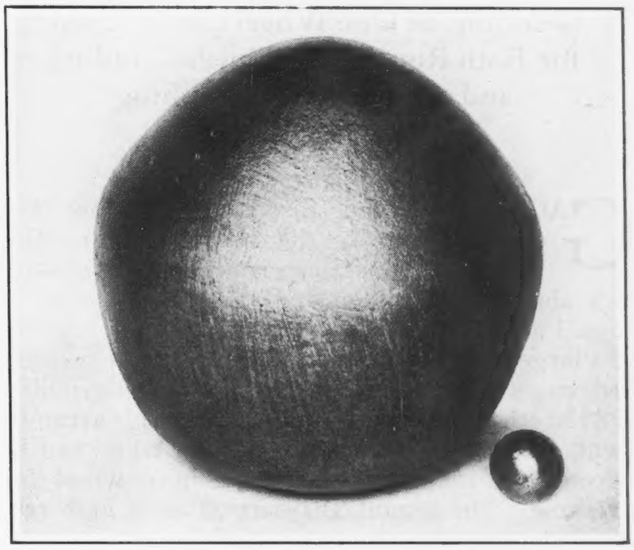
The broad economic problems that now trouble us are not isolated and circumscribed in character; most of them have long histories and many ramifications. It is true that some of the old economic theories developed in a handicraft age do not apply to our modern machine era, and the industrial engineer can do much to show their fallacious character. But on the whole, the engineer who aspires to solve modern economic problems must expect to do an unusual amount of studying before he can replace these old theories with others that are suited to our day and methods. Perhaps no field of knowledge presents such a bewildering array of theories which purport to tie together groups of phenomena more or less vaguely connected. He is indeed a bold man who will speak dogmatically about problems in political economy who has not studied this so-called "dismal science" long and carefully as a preparation.—*Dexter S. Kimball, Dean of the College of Engineering, Cornell University*

All Teeth of Gears Lapped Simultaneously

Lapping of gear teeth has played a big part in developing automobile transmissions to their present degree of refinement. In most gear-tooth lapping machines, the gears are run in mesh with laps that resemble the gears themselves, several teeth of the gear being in engagement at the same time with the lap or laps. A process in which all the teeth of the gear are lapped simultaneously by the engagement of the teeth with a lap which resembles an internal gear will be described in July MACHINERY.

The Rolling Action of Non-Spherical Balls

The discovery that the sphere is not the only solid having a constant or uniform diameter is claimed by two British engineers, Francis W. Shaw and Harry Shaw. It is possible to finish balls in the ordinary way—that is, by grinding between two parallel disks—so that they will have a constant thickness or diameter without being spheres. When such a ball is measured between two parallel planes,



Balls that while Not "Round" Still Have a Constant or Uniform Diameter as Measured by Parallel Plane Gages

the distance between the planes will be the same for any position of the ball, in spite of the fact that it is not spherical. The central point on each diameter of such non-spherical balls will be in a different position relative to the ball surface; and while, of course, the ball will have a center of gravity, it will not, in a sense, have a geometrical center.

To prove that this statement was true, the two engineers who discovered this principle made a 6-inch wooden ball and a 1-inch steel ball, as shown in the illustration. It will be readily seen that the large ball is not spherical; in fact, its radii of curvature vary from 1 to 5 inches. Yet the diameter or distance between two parallel planes tangent to the non-spherical ball is the same no matter how the ball is turned. Balls of this shape would operate properly between parallel plane surfaces or in ball races with a point contact at top and bottom.

* * *

A revision of the American tentative standard for annular ball bearings, single-row type, has been approved by the American Standards Association. Copies can be obtained from the American Standards Association, 29 W. 39th St., New York City.

Internal Grinding with Two Wheels on One Spindle

One Wheel Can be Used for Rough-Grinding and the Other for Finish-Grinding, or One Wheel Can be Used for Both Rough- and Finish-Grinding and the Other for Polishing

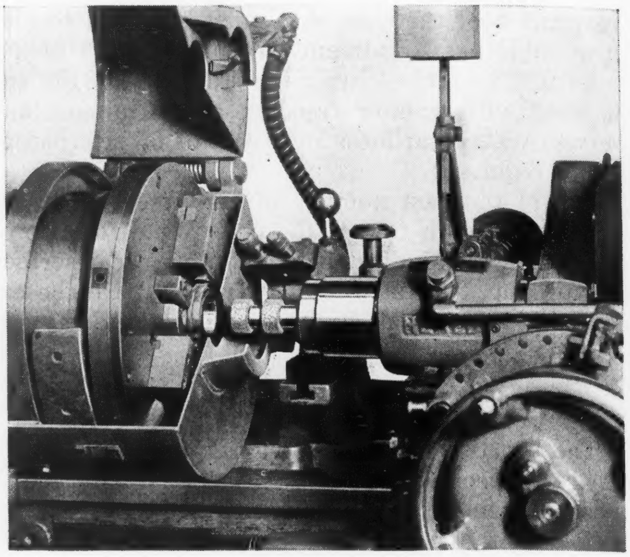


Fig. 1. Using Two Grinding Wheels on One Spindle for Rough- and Finish-grinding a Hole when a Large Amount of Stock Must be Removed and a Fine Finish Obtained

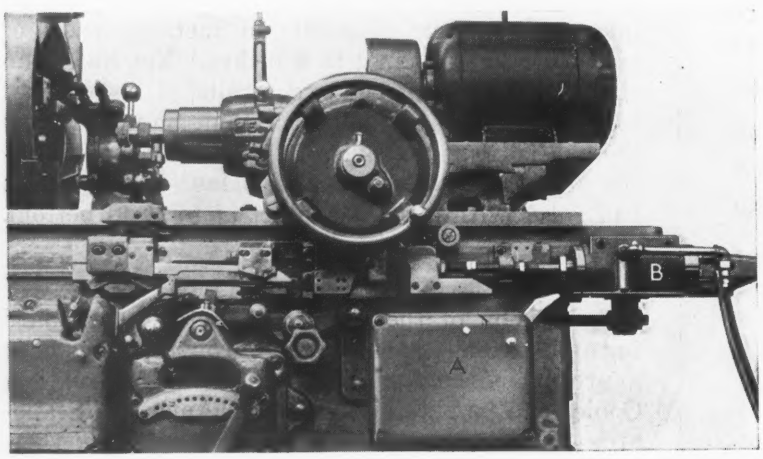
GAGEMATIC and Sizematic grinding machines, built by the Heald Machine Co., Worcester, Mass., can now be arranged with two abrasive wheels on one spindle, as shown in Figs. 1 and 2. When the work requires the removal of a large amount of stock and a fine finish is specified, one wheel can be employed for rough-grinding and the other for finish-grinding. With this arrangement, a relatively coarse free-cutting wheel can be selected for roughing, and a fine hard wheel for finishing. The advantages claimed are a high rate of production and maximum accuracy as a result of completely finishing the hole in one chucking of the work.

The machine is arranged as a single-gage Gagematic, having the truing contact on the handwheel in the Sizematic fashion and the finishing contact in the plug sizing device. The automatic cycle in rough-grinding with one wheel and finish-grinding with the other is illustrated diagrammatically in Fig. 3, and consists of first, starting; second, rough-grinding by using the rear wheel; third, truing both wheels and setting a dog-bar for finishing; fourth, finish-grinding by using the front wheel; and fifth, running out the table and resetting the dog-bar.

Truing is controlled in the usual way, and the finished size of the work is also controlled in the usual manner by means of a gage. A special mechanism incorporated in the plug sizing device keeps the gage withdrawn from the projecting finishing wheel during rough-grinding.

Since rough-grinding is done by the rear wheel, the cross-slide must be backed away when the table runs out for truing, in order to prevent the front wheel from striking the ground surface of the work. This is accomplished by a hydraulic mechanism similar to the standard type of backing-off attachment.

Fig. 2. An Operation in which One Abrasive Wheel is Employed for Rough- and Finish-grinding a Hole and a Second Wheel on the Same Spindle is Used for Polishing



When work must be given a mirror-like finish, a grinding wheel can be used for both roughing and finishing, after which a cork wheel impregnated with abrasive can be employed for polishing. Such an operation is shown in Fig. 2. Roughing, truing, and finishing are done in the normal Gagematic manner, with the front wheel under the control of roughing and finishing gages. When the finishing gage enters the work, a valve in a secondary control box *A* is actuated to allow oil to enter the hydraulic cylinder *B* at the right-hand end of the dog-bar. This moves the dog-bar endwise to bring the rear wheel into the polishing position. At the same time, the gages are withdrawn from the projecting wheel and a time relay is started.

The rear or polishing wheel is then allowed to float back and forth in the hole with very little feed, or none at all, until the time relay makes contact and the table runs out in the regular way. In such an operation, it is also necessary to back off the front slide when running out the table, so as to prevent the front wheel from striking the work.

In rough-grinding, finish-grinding, and polishing as described, the sequence of operations is as follows: First, start; second, rough-grind by using the front wheel; third, true both wheels; fourth, finish-grind by using the front wheel; fifth, shift dog-bar and polish by using the rear wheel; and sixth, run out the table and reset the dog-bar. Fig. 4 shows the successive steps in this series of operations. This method is suitable when the amount of stock to be removed is approximately normal. The finish obtained is comparable to that secured by lapping. Close tolerances for roundness and straightness can be maintained.

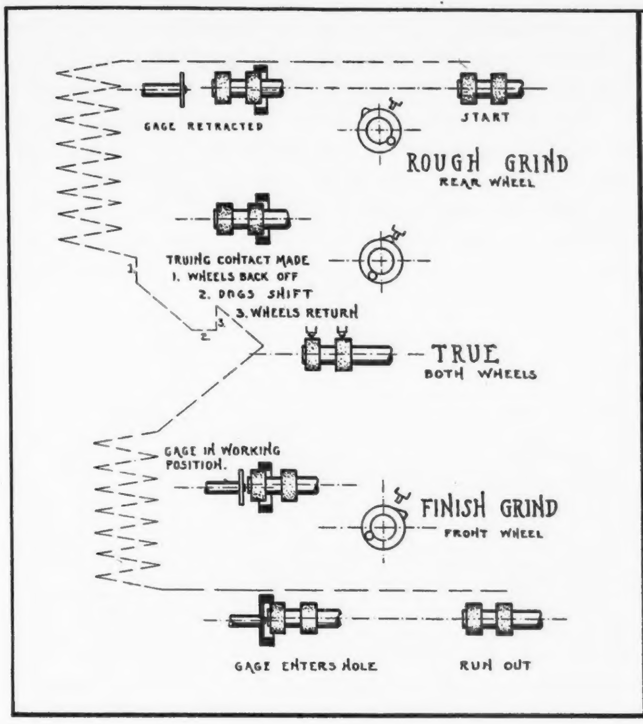


Fig. 3. Diagram Showing the Automatic Cycle in Rough- and Finish-grinding a Hole with Two Wheels on One Spindle of Gagematic and Sizematic Grinders

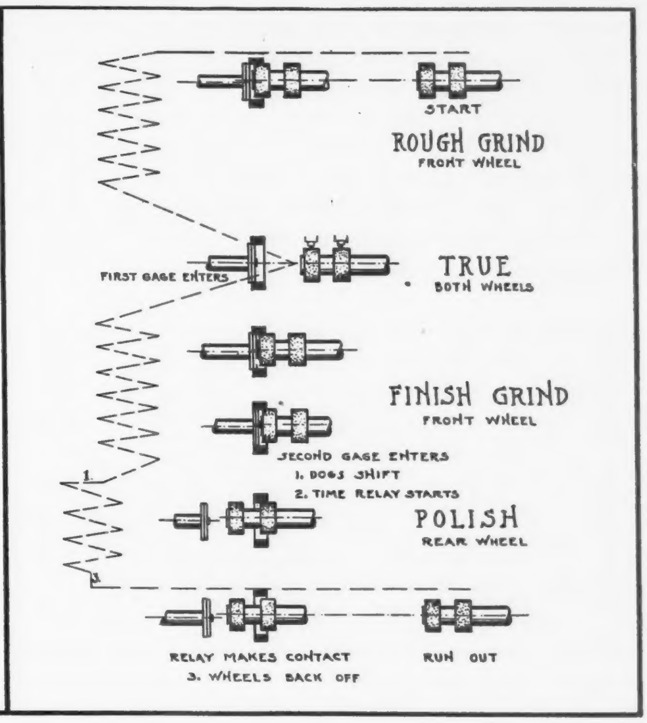


Fig. 4. Sequence of Automatic Operations in Rough- and Finish-grinding a Hole with One Wheel and Polishing with a Second Wheel on the Same Spindle

* * *

There are, in the United States, 4,500,000 passenger automobiles more than seven years old. It is generally considered that an automobile seven years old is ready for replacement. With improvement in business conditions, the replacement market in automobiles, therefore, is likely to be very active. About 17,000,000 passenger cars and trucks are three years old or older.

Exhibition of Machine Tool Builders Postponed

At the semi-annual meeting of the National Machine Tool Builders' Association held in Cleveland, April 24 and 25, it was decided to postpone the exhibition of the Association previously scheduled for Cleveland in September.

E. A. Muller, president of the King Machine Tool Co., was elected president of the Association. Mr. Muller has been acting president since the resignation of H. S. Beal. The other newly elected officers are as follows: First vice-president, Richard A. Heald of the Heald Machine Co.; and second vice-president, H. S. Robinson of the Cincinnati Shaper Co. H. M. Lucas, of the Lucas Machine Tool Co., was elected a member of the board of directors.

* * *

One of the gears of a giant steam shovel used by the Utah Construction Co. at Eagle, Colo., recently broke. A new gear was immediately ordered by telegraph from Chicago, with instructions that it be forwarded by air express. The gear, which weighed 56 pounds, left Chicago at 4:30 P.M., reached Denver at 3 o'clock the following morning, and was immediately transferred to a train for Eagle, where it arrived the same day. The distance covered was 1342 miles—1113 by air and 229 by rail.

Factors Influencing the Production of Wheel Lathes

By A. T. KUEHNER, The Niles Tool Works Co., Hamilton, Ohio

IN analyzing the production obtainable from a wheel lathe, it is a mistake to think only in terms of the capability of the machine itself to produce. There are other items of importance that affect the output. These may be represented by the following questions: (1) Is the machine properly erected on a substantial foundation? (2) Are the facilities for transferring the wheels to and from and in and out of the machine such as to expedite handling? (3) Is the operator capable of producing satisfactorily? (4) Are the treads difficult to turn? (5) Has proper allowance been made for the diameter of the tires turned? (6) Are the roughing and forming tools doing their respective share?

Assuming that the machine is properly erected, Questions 2, 3, 4, and 5 can be answered by direct inspection. Corrective measures can then be applied if necessary. Question 6, however, may be difficult to answer, and may require considerable time and attention in order to determine whether or not the performance of the roughing and forming tools is what it should be.

The turning of tires on railroad rolling equipment is one of the most difficult operations high-speed tool steel is called upon to perform. The reason for this is that the tool must turn a glazed surface, which is often filled with hard spots caused by either slid-flats or brake burns. Modern wheel

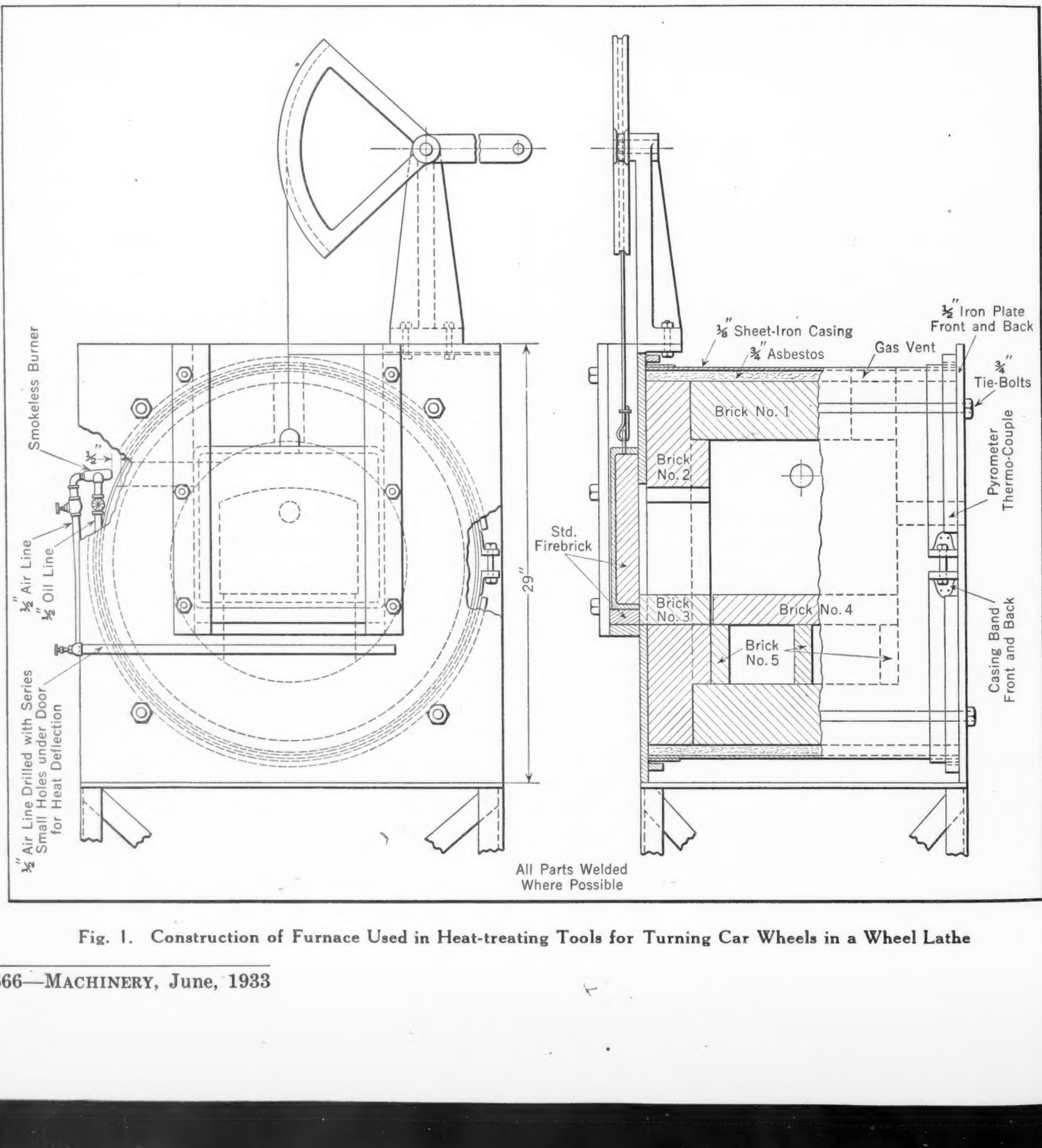


Fig. 1. Construction of Furnace Used in Heat-treating Tools for Turning Car Wheels in a Wheel Lathe

lathes have been so improved in ruggedness and design that they are capable of transmitting power to the cutting tool quite in excess of the strength of high-speed tool steel. Thus, any estimate of the production of wheel lathes must be based on the capacity of the tool to produce, as well as the performance of the wheel lathe itself.

This matter of tool-steel capacity is often referred to as cutting-tool production, and should be viewed from the following angles: The amount of feed per revolution of the wheel; the depth of cut necessary to reshape the flange; and the maximum cutting speed, in feet per minute, at which the lathe can be operated.

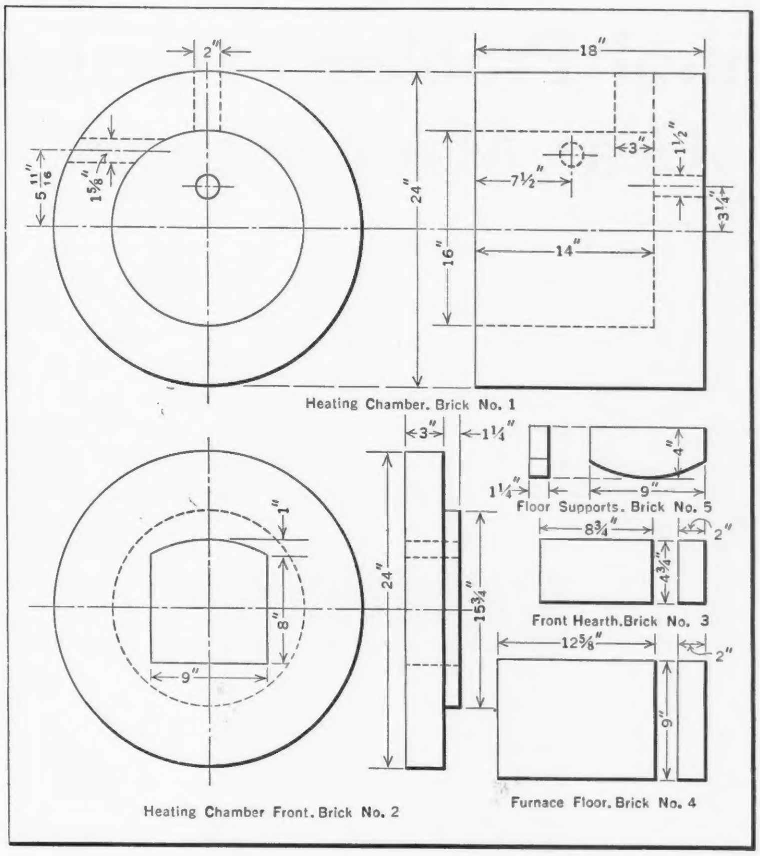


Fig. 2. Details of Bricks Used in the Heat-treating Furnace Shown in Fig. 1

In most instances, the amount of feed, generally about 3/8 to 9/16 inch, and the depth of cut do not materially affect production, but the rate of cutting speed does, as it is directly related to the ability of the tool steel to stand up under the heaviest cutting speed permitted. Full contribution of the tool to maximum output can be expected only when a good grade of high-speed steel is used and there are proper facilities for its heat-treatment and grinding.

The importance of these requirements can be more fully realized from tests that have been made of properly prepared tools. These tests show that the normal cutting speed of 14 feet per minute can be increased to 20 feet per minute on a modern wheel lathe without impairing the life of the cutting edge or causing chatter. At this speed, however, the operator has to be alert in order to use the "slow down" control provided. This control prevents the tools from digging into hard spots at the higher operating speed.

The heat-treating and grinding of all tire-turning tools must be entrusted to men experienced in this class of work, and proper equipment should be available for this work. When the proper heat-treating equipment is not available, an inexpensive furnace like that shown in Figs. 1 and 2 can be constructed. Bricks Nos. 1, 2, and 3 are made of fireclay, and bricks Nos. 4 and 5 are made of Carborundum. This furnace was designed especially for wheel-lathe tools, and these tools should be heat-treated according to the rules laid down by the steel manufacturer.

Faulty Pump Deliveries and Their Causes

By WILLIAM ANDERSON

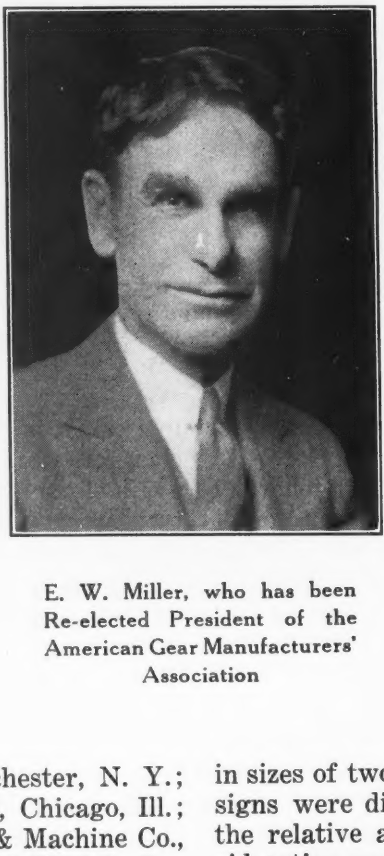
Pumps incorporated in machines frequently fail to deliver their rated capacities. This condition may be due to two causes—a poor connection between the foot-valve and the suction line or insufficient submergence of the foot-valve. The threaded connection on many foot-valves is rather short; and unless the suction-pipe thread is cut short and thoroughly reamed, a part of the thread or a burr will project into the chamber above the hinged check-flap. This projection will prevent the flap from opening fully, thus decreasing the area of the pipe at its inlet end and reducing the pump capacity.

Another point of importance is to make certain that the suction foot-valve is submerged sufficiently to prevent the pump from drawing in air with the liquid. If this valve is not placed far enough beneath the surface of the liquid, the velocity of the incoming liquid will create vortices or whirls which will carry air to the pump. A safe plan the writer has followed is to allow one foot submergence for each inch of diameter of the suction pipe. This rule holds good for sizes up to 8 inches, and provides ample submergence of the suction valve for obtaining full service.

Technical Problems Discussed by Gear Manufacturers

THE sessions of the seventeenth annual meeting of the American Gear Manufacturers' Association, held at Wilkinsburg, Pa., May 4 to 6, inclusive, were devoted to discussions of technical, selling, and management problems.

Optimism concerning future business was the keynote of the convention. It was estimated that at the present time the gear business is running from 22 to 26 per cent of a normal period. The following seven companies were admitted as members of the Association: The Ingersoll Milling Machine Co., Rockford, Ill.; National Tool Co., Cleveland, Ohio; Union Twist Drill Co., Athol, Mass.; National Broach & Machine Co., Detroit, Mich.; Watson-Flagg Machine Co., Paterson, N. J.; Synthane Corporation, Oaks, Pa.; and the Dominion Engineering Works, Ltd., Montreal, Canada.



E. W. Miller, who has been Re-elected President of the American Gear Manufacturers' Association

All the officers were re-elected for one year, as follows: President, E. W. Miller, Fellows Gear Shaper Co., Springfield, Vt.; first vice-president, John Christensen, Cincinnati Gear Co., Cincinnati, Ohio; second vice-president, A. A. Ross, General Electric Co., West Lynn, Mass.; treasurer, J. Harper Jackson, Pittsburgh Gear & Machine Co., Pittsburgh, Pa. The following directors were re-elected for three-year terms: A. C. Gleason, Gleason Works, Rochester, N. Y.; F. W. England, Illinois Tool Works, Chicago, Ill.; W. G. Jones, W. A. Jones Foundry & Machine Co., Chicago, Ill.; and A. A. Ross, General Electric Co., West Lynn, Mass. J. C. McQuiston continues as manager-secretary.

Cleaning Heat-Treated Gears by an Electro-Chemical Process

The first technical paper to be presented was prepared by Floyd T. Taylor, of the Bullard Co., Bridgeport, Conn. It discussed the advantages of removing scale from hardened gears and various de-scaling methods that are employed. The paper pointed out that the Bullard-Dunn process (described in October, 1930, MACHINERY) gives an electro-chemical action that removes scale without pitting, etching, or attacking the base metal. Instead, a microscopically thin metallic film, deposited during the scale-removing treatment, protects the base metal throughout the de-scaling operation. Further, this metal film, in combination with a light oil dip, is said to protect parts against rust while they are carried in stock. Details of the Bullard-Dunn process were given.

In a paper on the design and manufacture of large gears for such service as the operation of strip mills and blooming mills in steel plants, past and present methods of cutting the gears were discussed by Thomas Holloway, of the United Engineering & Foundry Co., Pittsburgh, Pa.

This paper pointed out the lack of a horsepower formula that includes all factors involved in the life of large gears and presented a formula that took into consideration the factors of service, material, and velocity. Tables were included of factors to be used for different gear speeds, various types of machines, and different materials.

The Increasing Application of Motorized Speed Reducers

R. S. Marthens, of the Nuttall Works of the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa., presented a paper dealing with motorized speed reducers. At least thirty-two concerns are now manufacturing these units in sizes of two horsepower and above. Various designs were discussed with a view to bringing out the relative advantages and disadvantages. Consideration was given to the different types of motors and various gears used by manufacturers. The desirability of a single horsepower rating plate for a unit instead of one plate for the motor and another for the gearing was stressed.

The compactness of combined motor and gear reduction units was emphasized as probably the most important factor influencing the purchaser. Examples were given to show the large savings in length, width, height, and weight that can be obtained through the use of this type of equipment.

The Heat-Treatment of Gears

In a paper describing the gear heat-treating practice of the Warner Gear Co., E. F. Davis said: "Gear blanks should be normalized after forging,

as gears annealed, but not normalized, always show more movement in the final hardening operation than gears that have been both normalized and annealed. Research into the cause of gear distortion has shown that lack of correct normalizing is one of the principal causes of gear noise. Normalizing is conducted at temperatures from 1700 to 1850 degrees F. It consists of bringing the gears up to temperature, holding them at that temperature from one to two hours, and then cooling them in the air at a fairly fast rate to prevent abnormal grain growth. Carburizing grades of steel should be normalized at a higher temperature than the carburizing temperature to avoid the distortion that would otherwise occur at a temperature of 1700 degrees F. in the carburizing boxes."

Other facts pointed out in the paper were as follows: Each type of steel must be annealed to some definite micro-pattern if the maximum machining results are to be obtained. The function of the gear metallurgist is to determine which structure is most desirable in gear cutting and then manipulate the annealing furnace until this structure is obtained consistently. A structure suitable when gear teeth are cut in a Fellows gear shaper may not be the best for a hobbed gear, and a structure suitable for a spur gear may not be the best for a helical gear.

The depth of carbon penetration in carburizing varies from 1/64 to 1/8 inch, depending upon the time and temperature, the latter usually being between 1650 and 1750 degrees F.

Oil-hardened gears almost invariably expand permanently in hardening, and this, of course, increases the diameter of the pitch circle, the increase usually approximating 0.001 inch per inch of diameter. The expansion is not always uniform, the design of the gear, the hardening temperature, and the type of steel all being factors. As a general thing, the lower the hardening temperature, the less will be the distortion.

When carburized gears are hardened, the movement is toward the hole, the periphery changing very little under good hardening practice. Hence, it would seem that there are greater possibilities for quiet gears from low-carbon steels than from the oil-hardened type.

Rate of Quenching is an Important Factor in Gear Distortion

The rate of quenching is one of the most important factors in gear distortion. Water quenching is avoided in the plant of the Warner Gear Co. whenever possible, yet even though oil has a milder quenching effect, it may be too severe for gears with fine-pitch teeth or thin sections. The oil quench can be modified by heating the oil and by avoiding agitation of the parts in the quenching bath. On the other hand, large gears may require considerable agitation in oil to produce the necessary hardness. A large gear could be quenched in water with less danger of distortion than when a very small gear is quenched in oil. Quenching conditions must be adjusted to the mass that is to be hardened.

Similar conditions apply to hardening temperatures. A small gear may distort excessively at 1500 degrees F., whereas a large gear may be hardened at 1650 degrees F. without harmful effects. The actual distortion occurs in the quench—strains are not developed during the heating of the gears. It was formerly the practice to double-heat-treat carburized gears, but this practice was one reason for noisy gears and has been largely abandoned.

Probably seventy-five per cent of the gears produced are now hardened in a cyanide bath. The cyanide process should be regarded as a semi-nitriding process, because nitrides as well as carbides constitute the case, the outer layers for a depth of 0.0005 inch showing a nitrogen content up to 14 per cent. Excellent wearing quality is the main advantage of the cyanide case.

"Another myth I would like to explode," said Mr. Davis, "is that cyaniding makes noisy gears. Bad tooth form is the chief cause of noisy gears."

Freedom of Design an Advantage of Welded Gears

When gears are made of welded steel, different materials can be readily used for the rim, web, etc. This latitude permits the designer to make the different gear members from materials that best adapt them for the functions they must perform. This advantage was emphasized in a paper presented by Everett Chapman, of Lukenweld, Inc., Coatesville, Pa., who also discussed the technique of welding the gears. The economic advantages of welded gears were also cited.

Worm-Gear Speed Reducers Tested to Determine Power Capacity and Obtain Lubrication Data

Chester B. Hamilton, Jr., of the Hamilton Gear & Machine Co., Toronto, Canada, made a report on extensive tests conducted during the past year with a view to determining the power transmitting ability of worm-gears under various operating conditions. Approximately six hundred full-load and overload tests to destruction, on standard high-duty worms and worm-gears, were studied. Worms with from 1 to 4 threads and pressure angles of 14 1/2 and 30 degrees were used in these tests.

This paper developed a new basis for a possible rational formula for the power rating of worm-gear drives. It was pointed out, however, that a formula could not be developed until further experiments had been made with units of different pitches and center distances. Another series of tests was made with various oils to compare their heating characteristics.

Gear Lapping after Heat-Treatment

In a paper on the lapping of gear teeth after heat-treatment, R. S. Drummond, president of the

National Broach & Machine Co., Detroit, Mich., stressed the fact that recent advances in gear correction practice have made it possible to remove economically all distortion resulting from normal heat-treatment. The life of the laps has been materially extended. From 500 to 1000 gears can be corrected without producing an error of more than 0.001 inch in the lap profile, even though the chordal thickness of the lap teeth may be reduced as much as from 0.030 to 0.060 inch.

Attention was called to the fact that the increasing demands of the automotive industry has made it necessary for gear manufacturers to remove errors in gear teeth to a much greater extent than used to be considered necessary. Past and present methods of lapping gear teeth were discussed.

Lap life depends to a great extent upon the cutting or lapping compound used. The grain for lapping should be of a rounded, irregular shape, but never needle-like. The National Broach & Machine Co. has found that a water-soluble compound is more efficient than one having an oil base.

The standard lapping time today for reasonably well cut gears is about 2 minutes for a gear having a 1-inch face and a pitch diameter of 4 inches. In lapping oil-treated gears, however, the standard lapping time for the same size of gear varies from 1 to 4 minutes.

Two papers on the commercial side of the gear business were presented as follows: "We Can't Get Business That Isn't Being Placed," by E. S. Sawtelle, of the Tool Steel Gear & Pinion Co., Cincinnati, Ohio, and "How to Arrive at the Price of a Non-Metallic Gear," by J. Harper Jackson, of the Pittsburgh Gear & Machine Co., Pittsburgh, Pa.

At the annual dinner, Dr. Phillips Thomas, of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., gave an educational talk on "An Hour with Science," in connection with which he demonstrated the cathode ray oscilloscope, Stoboglow Stroboscope, and various combinations of photoelectric and glow-grid tubes.

* * *

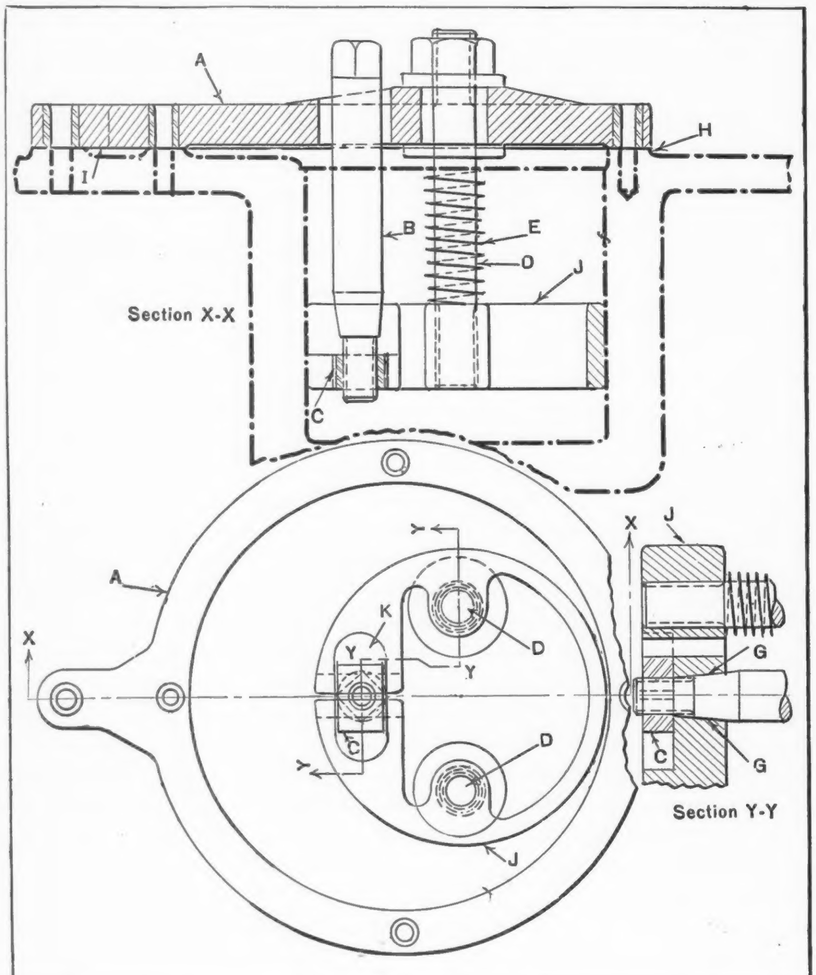
Templet Jig with Special Clamp

By J. E. FENNO

The jig shown in the accompanying illustration was designed for use in drilling five holes in the eccentric flange *H* and the boss *I* of a large tank. As there were no available projections for clamping a templet or jig plate directly in place, the device shown was provided with an internal clamp. The jig plate *A* is shaped to suit the contour of the flange and the boss to be drilled. The split ring *J* is a slip fit in the bored hole of the tank, and can be expanded so that it is securely clamped in the hole by the action of a tapered plug *B*.

The nut *C* in which the tapered plug turns is a floating fit in the recess *K*. The two studs *D*, which are screwed directly into the plate ring *J*, pass through the jig plate *A*. The latter member is clamped to the tank by tightening the collar nuts on the studs after the plate ring *J* has been clamped in place in the bored hole.

The springs *E* are provided to facilitate inserting the ring *J* to the proper depth in the bored hole. It will be noted that the holes in plate *A* through which members *B* and *D* pass are large enough to provide sufficient float for locating the jig plate in the correct position with respect to the contour of the casting flange and boss. This type of jig can be quickly and easily applied, the only tools required for its operation being a double-end wrench for the tapered plug and the collar nuts.



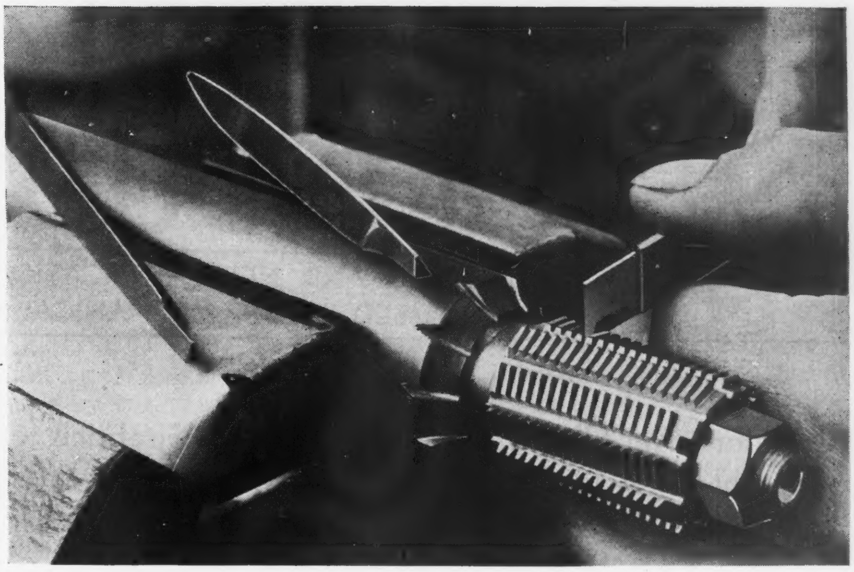
Templet Type Drill Jig with Internal Clamp

* * *

Extensive tests have proved, according to Fletcher Waller, Research Analyst, that noise not only reduces production in plants, but also greatly increases the workers' fatigue.

Relieving Hobs by Hand

By O. S. MARSHALL



Relieving the Teeth of a Hob by the Use of Specially Ground Hand Files

SPECIAL hobs are frequently required on short notice in one large machine tool plant, and to meet this situation the relieving operation is done by hand, as indicated in the illustration. While this method is a makeshift, it is one that is resorted to quite often. For instance, the writer has made no less than nine hobs with single, multiple, and quadruple threads within a period of eighteen months. To produce an accurate hob in this manner within a reasonable time, and also to simplify the operation for the workman, some study was devoted to ways and means.

The following is a description of the hand method as applied to a 1 1/4-inch diameter, 10-pitch, double-thread, worm-wheel hob. After finishing the threads, the flutes are cut normally. Next, the tops of the teeth are backed off with a flat-face cutter, removing 0.030 inch of metal at the rear of each tooth. The rear of the teeth is now cut, or "channeled," by hand to a depth of 0.030 inch below the root diameter of the hob. This will leave a definite line to work to in the second hand operation of relieving the teeth.

Three files are then selected (preferably of No. 2 cut)—one a flat file, 4 or 5 inches long, and the other two three-cornered, 5 or 6 inches long. The sides of the flat file are ground accurately parallel 1/2 to 3/4 inch from the front end and to a thickness equal to the width at the point of the threading tool—in this case 0.031 inch. The cutting edge of the file should be square with the ground sides.

The two three-cornered files are ground, one right-hand and the other left-hand, for use in relieving the sides of the teeth. They are ground back on one side a distance of about 3/4 inch, leaving an included angle of 29 degrees. The ground side serves as a safety edge. One corner of each file is also ground to prevent filing the root of the hob. These ground files are 0.003 to 0.005 inch narrower than the tooth space to allow them to pass freely between the teeth.

The first hand operation is to relieve the root portions of the hob with the edge of the flat file, using the top relief of the teeth as a guide for depth. This operation should be completed over the entire hob before relieving the sides. It is desirable to apply copper-sulphate solution to the front edges of the tooth sides in order to give better definition and to insure that these edges will remain untouched by the files. The best way to apply the solution is with a soft pine stick cut to a thin edge.

A thin band of brass or tin should be placed around the hob and a lip bent sharply to drop into the flute against the tooth faces. This provides a safety stop, preventing the ends of the files from touching the cutting edges of the teeth behind those being worked upon. When the root of each tooth is completed, it is a simple matter to relieve the sides with the three-cornered files, maintaining a close degree of accuracy. The accuracy of the completed hob will closely approximate that of a hob relieved by machine.

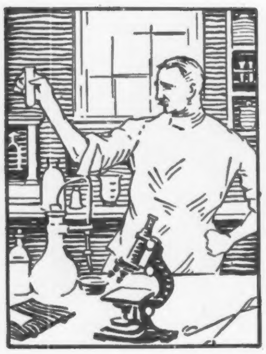
* * *

Manufacturing Staybolt Blanks with a Coin Press

A special coin press built by the Ferracute Machine Co., Bridgeton, N. J., has proved very efficient in producing staybolt blanks. The square head is formed and the bolt blank cut from the end of the bar in one operation, at the rate of thirty blanks per minute.

The forming dies are V-shaped, and there is an adjustable gage at the back of the press so that bolt blanks of various lengths can be cut off. A 7/8-inch steel bar is used in making a 7/8-inch staybolt.

The press is of compact construction, the frame being a solid casting with but 14 inches between columns. The stroke of the press is 2 inches. The head is adjustable downward as much as 1/2 inch by means of a wedge operated by a screw. The bolt at the top of the press keeps the head firmly up against the frame, a spring taking the weight of the head when the wedge adjustment is being operated.



MATERIALS OF INDUSTRY

PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Durichlor—An Alloy that Resists Hydrochloric Acid

A metal alloy that has a high degree of resistance to hydrochloric acid at all concentrations and temperatures up to the boiling point has been developed by the Duriron Co., Inc., Dayton, Ohio. Hydrochloric acid, which is widely used commercially, has a powerful corrosive effect on ordinary metals. Durichlor (the new alloy) is said to be comparatively inexpensive and is being used in making pumps, valves, pipe fittings, and other chemical-handling equipment.

Chrome-Nickel Silver—A New Rustproof Material

A rustproof alloy obtained by bonding nickel-silver sheet to chromium has been placed on the market by the American Nickeloid Co., Peru, Ill. This material is available both in flat sheets and strips, as well as in coils intended for use in the automatic operation of machines. Chrome-nickel silver, as the material is called, is highly resistant to tarnish and discoloration, and resists most acids and alkalies. It is easily worked, requires no polishing, plating, or lacquering after fabrication, and has long life.

This material can be supplied in any of the common gages, and in any sheet size up to 36 by 96 inches. However, for reasons of economy, it is preferable to specify a sheet width as narrow as possible. Either a bright polish or a satin finish can be provided.

Alloy Filler for Use in Tube Bending

A metal alloy known as "Bendalloy," which melts at 160 degrees F. and is intended for use in bending tubes of copper, Duralumin, aluminum, brass, steel, stainless steel, etc., is being marketed by Cerro de Pasco Copper Corporation, New York City. The alloy is melted and poured into the tube to be bent and then chilled to form a fine-grained structure that prevents the tube from collapsing while bending. The alloy metal can be melted and removed by simply immersing the tube in boiling water.

Firebrick for Intermediate Temperatures

Firebrick having a melting point of 3175 degrees F. has been brought out by Babcock & Wilcox, 85 Liberty St., New York City, for use in the field between the moderate service covered by fire-clay refractories and the severe service met by the B & W 80 firebrick. This new firebrick, which is known as 80 Junior, is intended for use under conditions in which B & W 80 would be uneconomical because of its price.

The new firebrick has a shrinkage of only 0.85 per cent after reheating to 2900 degrees F. for five hours. As it contains no free quartz, it is unusually resistant to spalling. In a test, this firebrick showed no deformation at 2660 degrees F., a 10 per cent deformation occurring at 2780 degrees F. This indicates that the firebrick can be used at temperatures close to its melting point.

Castings for High-Temperature High-Pressure Valves

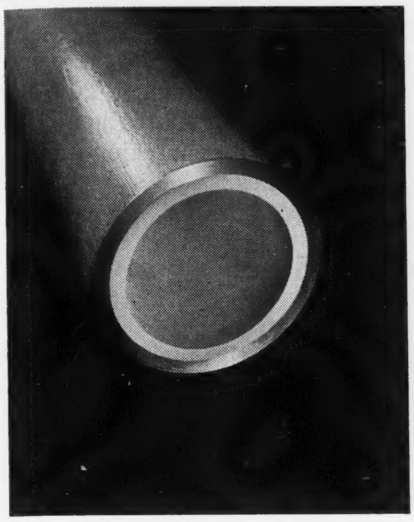
A 5 per cent chromium alloy containing molybdenum and 0.15 to 0.35 per cent carbon, known as "Circle L-10," has recently been added to the "L" group of alloy metals produced by the Lebanon Steel Foundry, Lebanon, Pa. Castings made from this material have high yield and small creep properties, combined with high strength and resistance to corrosion at high temperatures.

Because of its resistance to hydrogen-sulphide gas at high temperatures, this material is well adapted for high-temperature, high-pressure, oil-still valves and fittings. The tensile strength is from 110,000 to 125,000 pounds per square inch; the yield point from 75,000 to 90,000 pounds per square inch; the elongation, 16 to 20 per cent in 2 inches; the reduction in area, 30 to 55 per cent; and the Brinell hardness, 215 to 255.

A short-time test at temperatures around 1000 degrees F. showed the yield point to be 60,000 pounds per square inch and the tensile strength 75,000 pounds per square inch. A long-time creep test, under a tension of 10,500 pounds per square inch, at a temperature of about 1000 degrees F., showed an extension of 1 per cent in 10,000 hours.

Pipe with Cement Lining Resists Corrosion

Pipe with a cement lining that protects the inside surface from the corrosive action of fresh or salt water, hot or cold, and from many dilute chemical solutions, is a recent development of the National Tube Co., Pittsburgh, Pa. This "Duroline" pipe is made from the same steels and by the same processes as the regular black and galvanized wrought pipe produced by the concern. The material used for the lining has less than one-third the solubility of ordinary Portland cement mixtures.



Steel Pipe with a Lining of Cement, Suitable for Many Industrial Uses

Among the chemicals that can be conveyed in the pipe are copper sulphate, hydrogen sulphide, hydrogen peroxide, alum, sulphite liquor, dies, and bleaches.

This pipe is regularly made in nominal sizes of from 1/2 to 12 inches, and with a black or galvanized outside surface. Copper-steel pipe, also lined with cement, is recommended by the manufacturer for conditions where the pipe will be alternately wet and dry, and for use under mildly acidic conditions.

Bar Iron that Withstands Severe Vibration

Nordic iron is made by the Reading Iron Co., Philadelphia, Pa., for service in which parts made of bar iron are subject to severe vibration. This material is a wrought iron, suitable for use in the railway field for such parts as hangers, brake-rods, truck bolts, clevices, equalizers, spring bands, and other parts that are required to resist severe physical stresses, as well as corrosion. The iron is also suitable for making parts used on coal mine equipment, where the question of safety is of prime importance.

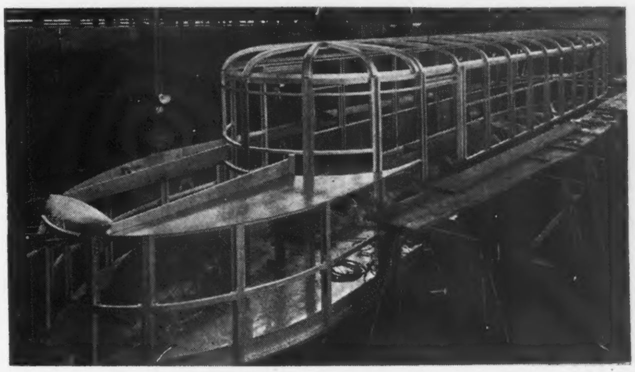
Nordic iron has an estimated strength of 48,930 pounds per square inch; a yield point of 30,120 pounds per square inch; an elongation of 34.6 per cent in 8 inches; and a reduction of area of 62.7 per cent. This material can be bent cold or hot and possesses free welding qualities. It is said to have the ability to withstand unusually high temperatures without damage.

First Power-Driven Railway Coach with All-Aluminum Body

The "Autotram" built by the Clark Equipment Co., Battle Creek, Mich., is the first power-driven railway coach having a body built entirely of strong aluminum alloys. All materials were selected for their ease of fabrication, as well as high strength-to-weight ratio.

The box type, "fish-belly" center sill, 59 1/2 feet long, is built of aluminum-alloy plate and shapes. The side sills are made from 6-inch by 3/8-inch bar and a special extruded "Z" section. The floor beams are 4-inch rolled structural channels. All window framing is made of extruded aluminum channels designed to permit easy installation and removal of glass. Window ledges and the roof-edge anchorage are special extruded sections. All roof car lines are special extruded channels of aluminum alloy, which permits cold-forming to the desired contour. The aluminum-alloy floor sheets are reinforced by angles placed longitudinally between the floor beams.

All forming was accomplished without resorting to the use of heat. To facilitate assembly and obtain a high degree of strength, special extruded channels are used for the body side posts. These channels not only provide the required stiffness and strength, but, because of the two flanges on each post permit both interior and exterior sheathing to be easily attached to the same member.



Aluminum-alloy Skeleton of the "Autotram"—a New Aluminum Railway Coach—View of Finished Car on Page 629

Hot-driven steel rivets were used in most of the assembly work, but the interior side sheets, ceiling partitions, and trim molding were attached by means of self-tapping steel screws. Rubber is used liberally at practically every point where there is metal-to-metal bearing in the car structure and trucks, as well as in the wheels in order to deaden vibration and noise. The motor and other rotating equipment is mounted on live rubber to minimize the transmission of noise and vibration.

The wheels are a patented design developed jointly by the Clark Equipment Co. and the B. F. Goodrich Co., Akron, Ohio. In these composite cushion-type wheels, the rubber that provides the

resilience is utilized in shear rather than in compression as is customary.

The "Autotram" is made in two sizes: The smaller one is 60 feet long, accommodates forty-two passengers, and weighs 30,000 pounds; the larger model is 80 feet long, accommodates sixty-four passengers, and weighs 50,000 pounds. This new car is designed to accelerate from 0 to 40 miles an hour in 52 seconds. It can be stopped within 1200 feet from a speed of 70 miles an hour, and within 180 feet from a speed of 35 miles an hour.

Chromium Steels Meet Problems of Food-Canning Industry

In canning food, care must be taken to prevent the contamination of the food through its corrosive action on the machinery used. When food acids attack metals and alloys, a metallic taste or some other undesirable change in the product often results.

Stainless steels of the straight chromium and chrome-nickel types have been found especially suitable for combatting the action of food acids. Straight chromium steels containing from 12 to 18 per cent chromium are highly resistant to the action of milk, fruit, and vegetable juices, meat products, sugar solutions, chocolate, vinegar at high temperatures, vegetable oils, and animal oils. Stainless steel of the 18-8 chrome-nickel variety are also resistant to these food products and to other highly corrosive substances. Another advantage of these alloy steels is that they are unaffected by cleansing and sterilizing agents.

The Materials in an All-Metal Plane

Commercial airplanes of all-metal construction, capable of carrying ten passengers with their baggage, two pilots, a stewardess, and 400 pounds of cargo, at speeds up to 182 miles an hour, are being placed in service by United Air Lines, Chicago, Ill.

It is interesting to note what such a plane is made of. Duralumin is the principal material, but in addition, bronze is used for certain bushings; stainless steel for exhaust stacks and ball and roller bearings; chrome-molybdenum steel for landing gears, engine mounts, tail wheels and wing terminals; brass and copper for electrical connections; steel and bronze for worm-gear drives; and aluminum for fuel tanks. These materials have been selected to give maximum strength within the weight limit, the planes weighing approximately 6 tons.

The metal construction is said to be a factor of prime importance, not only in the strength of these airplanes, but in their operating economy as well. Contrasted with fabric, the "metal skin" does not stretch with use or tear easily. Streamlining and fairing are facilitated.

Heat-treatments are used to increase the tensile strength of both the Duralumin and steel used in building these airplanes. In the case of Duralumin, the normal tensile strength of about 26,000 pounds per square inch is increased to about 55,000 pounds per square inch. The chrome-molybdenum steel used for landing gear parts and spar chords is raised from a normal tensile strength of about 90,000 pounds per square inch to 180,000 pounds per square inch. Nickel steel, such as is used for terminals, bolts, trunnions, etc., and for certain forgings, is raised from a normal tensile strength of about 90,000 pounds per square inch to 200,000 pounds per square inch. All steel parts are cadmium-plated to protect them from corrosion and to provide a better base for finishes.

Hot-Rolled Seamless-Steel Boiler Tubes

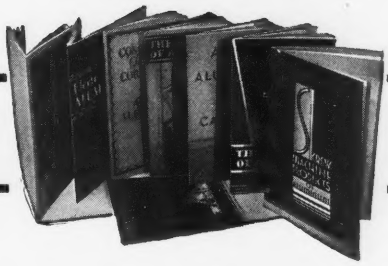
Unusual smoothness of both the inside and outside surfaces is one of the principal features of a line of hot-rolled seamless steel boiler tubes made by the Jones & Laughlin Steel Corporation, Pittsburgh, Pa. This smoothness is claimed to be an important factor in retarding corrosion when the tubes are in use and in minimizing depreciation while they are kept in stock. It also provides an attractive appearance.

Exceptional ductility is another advantage of the tubes, which facilitates rolling in and beading operations. The tubes are manufactured in a push-bench mill believed to be the only one of its kind in this country. The product complies with the A.S.M.E. Boiler Code, the A.S.T.M. Specifications, and the U. S. Steamboat Inspection Service Rules and Regulations.

Cold-Rolled Stainless Steel as a Structural Material

Cold-rolled 18-8 stainless steel is now being used successfully for structural members of airplanes, rail cars, motor buses, etc. Light weight, high strength, and resistance to corrosion are features of the fabricated structural members produced for these comparatively new applications. A floor beam about 5 feet long with a service-load capacity of 10 tons, for example, weighs only 10 pounds. This beam is typical of the type now being fabricated from channels and plates of cold-rolled stainless steel assembled by shot-welding.

The 18-8 steel, being austenitic, is hardened somewhat by cold-working. This property is usually undesirable, but in the case of light structural strip stock, it has been used to advantage in producing a material that has a tensile strength of 150,000 to 180,000 pounds per square inch. It is claimed that the use of this cold-rolled stainless steel for the structural members of a passenger coach resulted in a saving in weight of 75 per cent.

NEW TRADE  LITERATURE

Recent Publications on Machine Shop Equipment, Unit Parts, and Materials. Copies can be Obtained by Writing Directly to the Manufacturer.

BRASS PRODUCTS. Scovill Mfg. Co., 95 Mill St., Waterbury, Conn. New Scovill Mill Products Price Book, containing prices of the complete line of products made by this concern, including roll and sheet brass and bronze; nickel-silver sheets and rolls; roll and sheet phosphor-bronze; Alcunic sheets; brass, bronze, and nickel-silver wire in coils; brass, bronze, nickel-silver, and Alcunic rods; seamless brass tubing, copper service tubing, and condenser tubing; extruded shapes; and forgings or die pressings. In addition to complete tables for mill products, this catalogue also contains a data section made up of reference tables useful to anyone working with metals.

ELECTRIC WELD TUBING. Steel & Tubes, Inc., 223 E. 131st St., Cleveland, Ohio, a unit of the Republic Steel Corporation, Youngstown, Ohio. Handbook of electric weld tubing, containing information on the manufacture of electric weld tubing, weld characteristics, selection of material, physical properties, methods of cutting tubes into short lengths, bending, checking formed tubes, and other data of value to those interested in this class of materials. The book also contains convenient tabulated information, such as standard sizes and gages, tolerances of welded tubing, weights, minimum bending radii, hydraulic testing pressures, hardness conversion tables, etc.

VALVES, FITTINGS, FABRICATED PIPE, ETC. Crane Co., 836 S. Michigan Ave., Chicago, Ill. Circular entitled ". . . Born of Retrenchment," dealing with the broad subject of waste, and discussing the following questions: Has retrenchment gone too far? Are plant savings defeating their purpose? Where can management find new savings? Pamphlet entitled "After Three Years of Starvation Maintenance," suggesting practical methods of eliminating waste as regards piping equipment.

HYDRAULIC PRESSES. John Robertson Co., Inc., 121 Water St., Brooklyn, N. Y., is distributing the first issue of a regular publication to be known as "Robertson Reminders," which will contain information on the Robertson line of extrusion presses, lead-encasing presses, and platen presses for embossing and forming, as well as other hydraulic equipment, including pumps, valves, pipes and fittings, etc. Illustrations of the various products and of actual installations will be included.

PRECISION JIG-BORING MACHINES. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland (American representative, R. Y. Ferner Co., 1133 Investment Bldg., Washington, D. C.). Catalogue 560, illustrating and describing a new model Sip jig-boring machine, designated MP-2C, which has a capacity of 8 by 12 inches and several unique features adapting it especially for the rapid laying out, drilling, and boring of holes up to 1 1/2 inches.

CARBOLOY TOOLS. Carboloy Co., Inc., 2481 E. Grand Blvd., Detroit, Mich. Booklet entitled "How to Make Your Own Carboloy Cemented Carbide Tools." This is an instruction manual giving detailed directions for making complete tools from purchased cemented-carbide tips. The instructions include sections on designing the tool, machining the shank, and brazing the tip to the shank.

SCREW STEEL. Union Drawn Steel Co., Beaver Falls, Pa. Pamphlet containing data on Union Supercut screw steel. The pamphlet contains reproductions of set-up sheets showing the comparative increase in production obtained through the use of this steel. The set-ups are taken from actual practice. Complete data are given for the various jobs illustrated.

ABRASIVE SLEEVES. Cleveland Container Co., Abrasive Division, 10730 Berea Road, Cleveland, Ohio. Circular entitled "Nolap Abrasive Sleeves Assure Maximum Production with Portable Grinders," illustrating the application of these sleeves and describing the advantages of their use in connection with portable grinders.

VIBRATION-ABSORBING MATERIALS. Armstrong Cork & Insulation Co., Lancaster, Pa. Circular illustrating a variety of installations of Armstrong Vibra-cork, a material that absorbs vibration and reduces noise. The circular also illustrates diagrammatically methods of applying this material to different kinds of equipment.

MERCURY SWITCHES. General Wire & Switch Co., 140 Benedict St., Providence, R. I. Bulletin illustrating and describing mercury switches that include a new type of mercury circuit controller known as the "Mercrelay." The construction and advantages of this new development in electrical circuit control are described in detail.

PRECISION BENCH LATHES. South Bend Lathe Works, 425 E. Madison St., South Bend, Ind. Circular 9-G, illustrating and describing the 9-inch No. 20 toolmakers' precision lathe made by this company. The circular shows a variety of jobs for which this lathe is suitable and gives complete specifications, including prices.

ABRASIVE MATERIALS. Carborundum Co., Niagara Falls, N. Y., has published, in booklet form, the complete series of articles "How to Obtain Best Results in Roll-grinding" appearing in MACHINERY from January to May, 1933, inclusive. These booklets are available to those interested, upon request.

TESTING EQUIPMENT. Amthor Testing Instrument Co., Inc., 309 Johnson St., Brooklyn, N. Y. Circular 107, describing a new portable bursting-strength tester, tensile-strength testers, and a pocket thickness gage designed for the rapid testing of such materials as paper product supplies, rubber, wire, etc.

ZINC PRODUCTS. New Jersey Zinc Co., 160 Front St., New York City. Bulletin containing a reprint of two articles entitled "Meet Zinc—a Metal You Ought to Know," in which some of the many applications of zinc are described. The second of the articles deals particularly with zinc die-castings.

WELDING RODS. American Manganese Steel Co., 389 E. 14th St., Chicago Heights, Ill. Circular containing information on Amsco nickel-manganese steel welding rods, and No. 459 hard-surfacing welding rods. Instructions for welding and hard-surfacing with these rods are included.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Loose-leaf circulars GEA 1695, 1714, and 1728A, dealing, respectively, with quiet induction motors, sound-isolating motor bases, and portable cable for arc welding, mining machinery, electric shovels, etc.

HYDROGEN WELDING EQUIPMENT. Bundy Tubing Co., Detroit, Mich. Booklet entitled "Hydrogen Welding by Bundy," discussing this method of assembly in detail. The book tells what hydrogen welding is, points out its advantages, and suggests possible applications.

PIPE COMPOUNDS. Technical Products Co., Pittsburgh, Pa. New pipe-fitter's folder No. 5, containing information on connecting standard or special material pipe and conduit for conveying water, gas, acids, oil, etc., with "Sauer Eisen" technical pipe compounds.

VARIABLE-SPEED TRANSMISSION. Reeves Pulley Co., Columbus, Ind. Circular outlining the advantages of the Reeves variable-speed transmission and the results that can be obtained with this equipment. Typical applications are illustrated.

TRACK WELDERS. Lincoln Electric Co., Cleveland, Ohio. Specification bulletins S-3655 and S-3656, illustrating applications of the Lincoln quick-removable track welder and the Lincoln self-propelling track welder, respectively.

STEEL CASTINGS. Sivyer Steel Casting Co., Milwaukee, Wis., is publishing a periodical known as "Ladle Sparks," the first number of which contains articles on applications of stainless steel for cast parts.

PHOTOMICROGRAPHIC EQUIPMENT. Bausch & Lomb Optical Co., Rochester, N. Y. Circular treating of low-power photomicrography with the Micro-Tessar, a short-focus lens designed especially for this work.

CONCRETE FLOORS. Portland Cement Association, 33 W. Grand Ave., Chicago, Ill. Folders entitled "Concrete Floors for Industrial Buildings" and "Concrete Floors—How to Build Them."

STEEL FACTORY EQUIPMENT. Angle Steel Stool Co., Plainwell, Mich. Circular illustrating typical examples of the line of steel trucks, tables, chairs, stools, cabinets, and racks made by this concern.

AUTOMATIC CONTROL VALVES. Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa. Bulletin YB-2001, illustrating and describing the Yarway-Becker automatic control valve for pneumatic tools.

PULLEYS. American Pulley Co., Philadelphia, Pa. Bulletin on single "A" groove sheaves and single "B" sheaves, giving complete information on pulley sizes and corresponding belt sizes.

COLLOIDAL GRAPHITE PRODUCTS. Acheson Oildag Co., Port Huron, Mich. Technical bulletin pertaining to the use of "Aquadag" in the rubber industry for making insulation tests.

Building up Patterns with Linoleum

When a pattern of slightly different dimensions than the regular or standard one is required, considerable expense and time can sometimes be saved by using scrap linoleum to build up the surfaces of the pattern to the required dimensions instead of making a new one. Many patterns that require only a slight change in the diameter are easily taken care of in this manner.

When it is desired to cast steel from a pattern designed for cast iron or to cast iron from a pattern designed for brass, the necessary building up of the pattern can readily be done with linoleum. Also, this material is very useful in building up a standard gear blank pattern to provide for one more gear tooth than the standard number. The accompanying illustration shows a worker in the Nuttall plant of the Westinghouse Electric & Mfg. Co., applying linoleum to a 120-inch forming press gear pattern to thicken the rim. To increase the diameter, the linoleum is, of course, added to the outer face.

Applying Linoleum to Thicken the Rim of a Gear Pattern

The "Industrial Farm"

A booklet dealing with a problem of considerable importance when industrial conditions are as they have been during the last two or three years has been published by the B. F. Goodrich Co., Akron, Ohio, under the title "Industrial Cooperative Gardening—the Story of a Cooperative Farm Plan." This project provided last year over 1,000,000 pounds of vegetables for nine hundred workers and their families. It has been shown that with a properly prepared plan, one day's work per week for each worker over a twenty-five week period will provide vegetables for a family for thirty-six weeks.

* * *

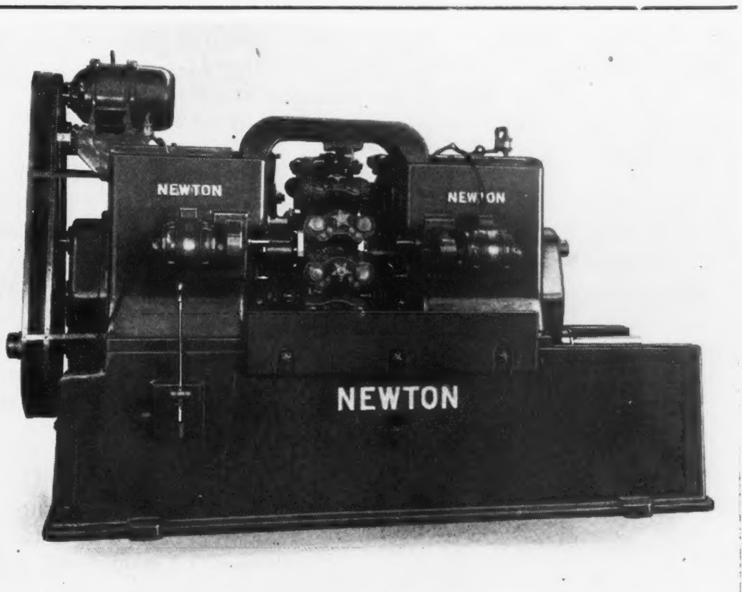
In many a plant where care is taken not to waste a quarter's worth of materials, a man with $200 worth of training is dismissed without hesitation.

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts and Material-Handling Appliances Recently Placed on the Market

Newton Drum-Type Milling and Center-Drilling Machine

Work from 6 to 30 inches in length can be rough- and finish-milled on both ends, and center-drilled, in a machine recently built by the Newton Division of the Consolidated Machine Tool Corporation of America, Rochester, N. Y. The particular machine illustrated was designed for facing and center-drilling oil-pump brackets in an automobile plant. It is also suitable for handling other castings and pump shafts, propeller shafts, etc. Similar machines capable of taking work 72 inches in length or more can also be furnished.



Newton High-production Machine for Rough- and Finish-milling and Center-drilling the Ends of Parts

The machine operates continuously, being merely unloaded and loaded by the operator at one station. The clamps that hold the work in place are automatically tightened as the drum revolves. After the work has passed the milling cutters and the center drills, these clamps are automatically loosened. The machine is regularly equipped with six spindles, two for the rough-milling cutters, two for the finish-milling cutters, and two for the drills.

The top bracket on the machine carries the device which loosens the clamps on the work drum. When the adjustable cutter head is moved on the housing to accommodate longer shafts, a different drum equipped with suitable work-holding fixtures, must be substituted for the drum shown. Also, another top bracket must be provided.

Chips are disposed of by a gravity feed, while the cutting lubricant drains into a reservoir at the back of the machine. Anti-friction bearings are supplied throughout and there is a centralized lubrication system, the drive and feed gears running in oil. It is estimated that the production of the machine will be as high as 300 to 400 pieces an hour, depending upon the job. This estimate is based upon a proper rate of feed to suit the material from which the work is made, and upon the diameter of the cut circle. Three motors are required, the main drive motor at the top and two separate motors for the drill spindles.

Schatz Bending Roll which Pre-Bends Plate Ends

A special machine for rolling plates up to 35 feet in length, ready for welding into pipe, is being introduced to the trade by the Schatz Mfg. Co., Poughkeepsie, N. Y. One of the features of this machine is that it will pre-bend the ends of a plate to the proper radius, thus eliminating the need of auxiliary equipment for pre-bending or crimping. This pre-bending feature is obtained by locating the main rolls with respect to each

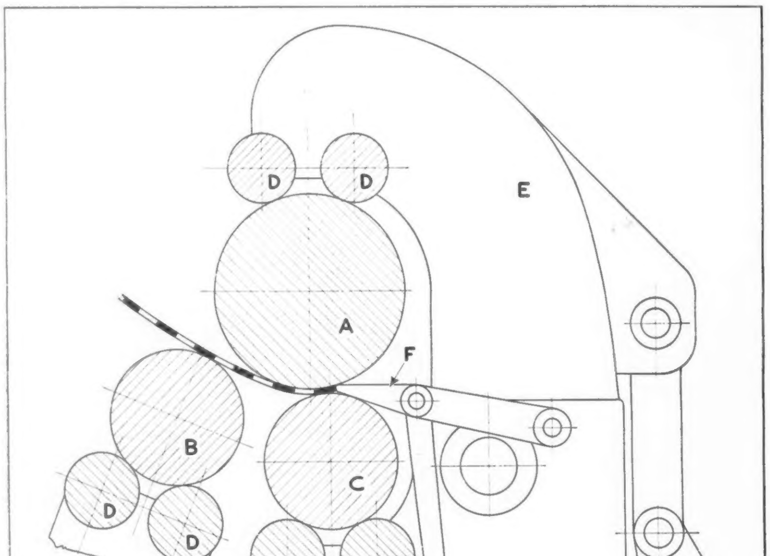
other as shown at *A*, *B*, and *C* in the accompanying cross-sectional view. These rolls are all positively driven. In pre-bending, the plate end is fed against a stop-gage *F*, which is mechanically withdrawn before the rolling of the pipe proceeds.

Since it takes considerably more pressure to pre-bend plate ends than is required for rounding the plate into a pipe, all three main rolls are supported by adjustable pressure rolls *D*. This also enables the diameter of top roll *A* to be kept at a minimum, so as to permit the production of as small diameter pipe as possible. Additional supporting rolls are positioned along roll *C*. Rolls *D* for top roll *A* are mounted in a housing *E*, which is swung away mechanically after the plate ends have been crimped, so as to permit complete rounding of the pipe without interference. Roll *A* is tilted and its end bearing opened simultaneously by power for withdrawing the finished cylinder.

A 35-foot machine designed for handling 5/8-inch plate will bend pipe of the maximum length and thickness to a minimum diameter of 33 1/2 inches over a 25 1/2-inch diameter top roll *A*. Lighter plates can be completely wrapped around roll *A*, its supporting rolls being so arranged as to permit the plate to pass between them and the main roll. Smaller diameter top rolls and mandrels can be placed in the machine for rolling still smaller pipe, thus making the machine even more versatile.

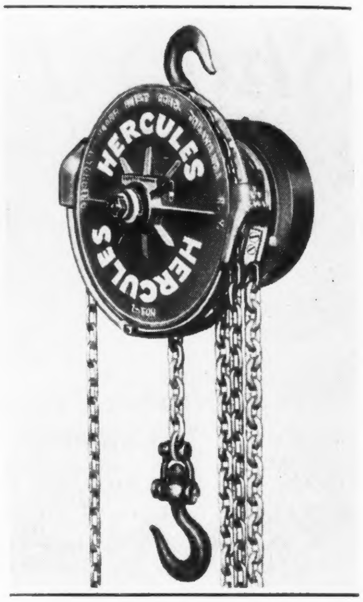
There is a correctional device to compensate for any spring in the rolls, thus insuring an accurate product that is not "fish-shaped." Operations are controlled from an elevated platform that enables the operator to completely see the work at all times. A large scale shows the proper roll settings for different sizes of pipe.

The 35-foot by 5/8-inch machine is driven by a 110-horsepower motor and weighs between 300,000 and 400,000 pounds. In addition to the 35-foot length, the machine can be readily built in lengths of 16 feet and upward.



Sectional View, Showing Arrangement of Rolls on the Schatz Special Long-plate Bending Roll

High-Speed Hoists with Safety Governor



High-speed Hoist with Overload Governor and Adjustable Brake

Hercules high-speed hoists with a patented safety overload governor have been added to the line of the Chisholm-Moore Hoist Corporation, Tonawanda, N. Y. The governor, which warns against excessive overloads and protects the hoist, load, and operator against accidents, is tested and sealed at the factory.

Another feature of these hoists is an adjustable load brake, designed to prevent self-lowering of the load. A "quick-lowering" device is optional in the smaller hoists. These hoists are available in capacities ranging from 1/4 ton to 40 tons. They are equipped with electric welded Inswell load chain.

Simplex Abrasive-Band Grinder

A pedestal-type abrasive-band grinder equipped with a 3/4-horsepower fully enclosed motor that drives through a roller chain has been placed on the market by the Walls Sales Corporation, 96 Warren St., New York City. This Simplex-M-6 grinder is intended for production work. The abrasive belt runs at 1900 feet per minute. Among the features of the equipment are an improved single thumb-screw arrangement for aligning the belt,

Abrasive-band Grinder with Enclosed Motor that Drives through a Roller Chain

a removable bevel attachment, dustproof ball bearings, and an Alemite lubricating system. The grinding table measures 7 3/4 by 14 inches, the abrasive band being 6 inches wide by 48 inches long. The machine weighs 425 pounds.

Splash-Proof Motor

A splash-proof motor especially designed for use in dairies, breweries, and similar places where water or other liquids may be splashed on the motor, has been produced by the Ideal Electric & Mfg. Co., Mansfield, Ohio. This motor is also suitable for use on equipment that is frequently washed with a hose, since a stream of water striking the motor at any angle, or even pointed directly into the ventilation duct, will not wet the windings.

This motor is made in all sizes from 1 to 200 horsepower in a squirrel-cage induction style, and also in sizes up to 200 horsepower in an across-the-line start type.

Power Press Drawing Devices Designed for Small Movement

The Simplex drawing device made by the Rockford Iron Works, 648 Race St., Rockford, Ill., to enable deep drawing operations to be performed on single-action power presses has recently been redesigned to make it more compact and thus reduce the space required under presses for its installation. Fig. 1 shows the improved device. Being shorter than formerly, it is not likely to interfere with the leg tie-rods of an inclinable press, and when applied to straight-sided presses, it can be installed above the floor line.

In operation, this drawing device converts the downward movement of the press ram and of the pressure-ring into a general upward motion of the center block. As a result, the device automatically balances the pressure exerted on the opposite sides of a blank and holds it to just the amount required for drawing that particular shell. In the improved design, the spring that returns the pressure plate has been removed from the center rod, where it was formerly located, and placed in pockets in the pressure plate and yoke. This change has enabled the unit to be shortened practically 25 per cent. The device can be furnished for any sized press.

A rubber bumper, also recently developed by the same concern, permits the drawing of shells up to 2 1/2 inches deep from light and medium-gage material, with a bumper compression that is only a small proportion of the stamping depth. This device is known as the Acme die cushion and is illustrated in Fig. 2. A compensating mechanism reduces the movement of the rubber pads to a minimum and thus prolongs their life.

In an operation, the levers seen in the illustration move laterally toward the center when the press ram descends, instead of moving directly downward. An important feature of the device is the fact that the plate with which the rollers come in contact is so machined that the pressure on the blank remains almost constant. The pressure required to eliminate wrinkles on a blank is adjustable through a nut. This die cushion can be applied to any make of press.

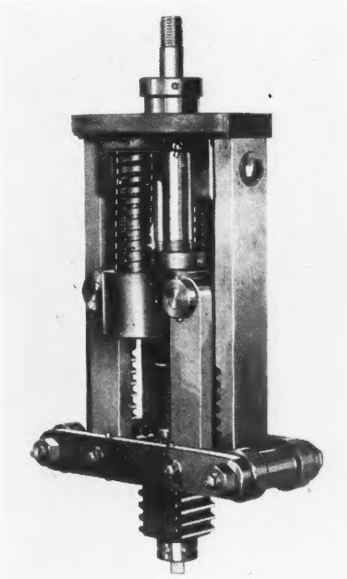


Fig. 1. Simplex Drawing Device Redesigned for Compactness

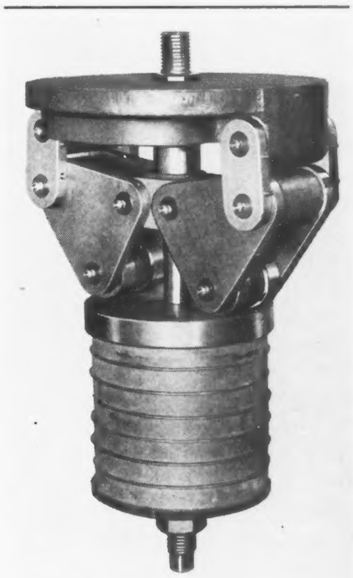
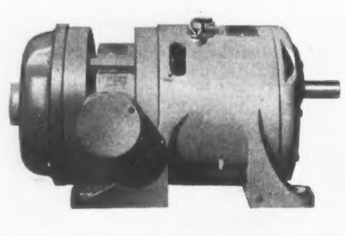


Fig. 2. Acme Die Cushion Designed for Minimum Movement



Reliance "Gearmotor" with Adjustable Cartridge-type Gear Unit

Reliance "Gearmotors" with Adjustable Gear Unit

A new line of "Gearmotors" known as Type S, in sizes rated at 3/4 horsepower and upward, is being placed on the market by the Reliance Electric & Engineering Co., 1042-1090 Ivanhoe Road, Cleveland, Ohio. A cartridge-type unit carries all gears and bearings except the high-speed pinion and bearing. This cartridge can be readily removed without disturbing the alignment of any gears or bearings. The oil height is checked by means of a bayonet-type gage.

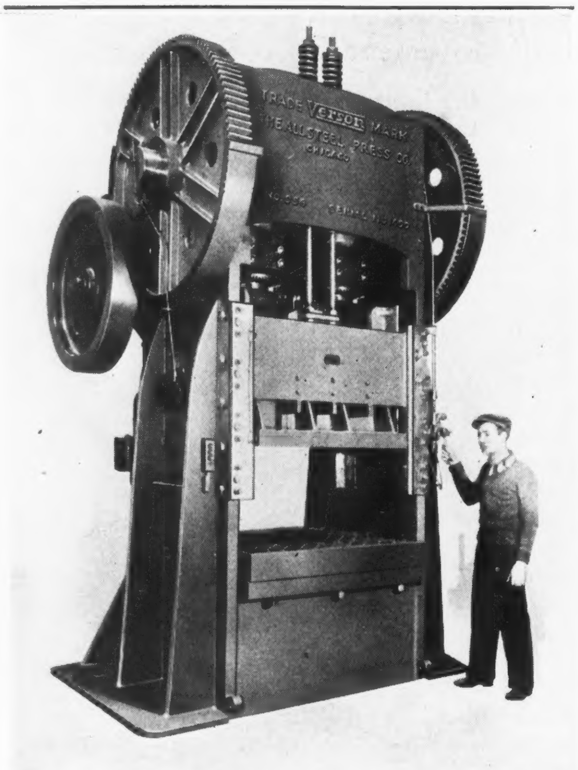
The ratio of a unit can be readily altered by simply changing the high-speed pinion and gear. From four to eight positions of the output shaft are obtainable by rotating the cartridge unit. These "Gearmotors" can be supplied in a wide range of ratios, and with either alternating- or direct-current motors.

Allsteel Double-Crank Press with Solid Frame

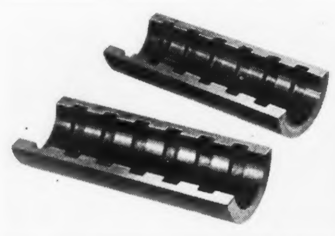
Double-crank presses with a "solid" frame of welded steel have been brought out by the Allsteel Press Co., 12015 S. Peoria St., Chicago, Ill., to complement the double-crank presses of tie-rod frame construction that have been described in MACHINERY in the past. The new presses are built in all sizes and capacities.

The friction clutch and brake are air-operated and are mounted between the housings, together with the motor and drive. Power is delivered evenly through two flywheels, one on each end of the high-speed back-shaft. This shaft runs in roller bearings. Automatic force-feed lubrication is provided, and there is a motor adjustment for the ram. The steel gibs and gib ways are faced with renewable bronze liners. Floor space is saved through the elimination of supporting arms and brackets.

The No. 956 press illustrated is of 350 tons capacity. It has a 42- by 56-inch bed area, a shut height of 16 inches, a stroke of 8 inches, and a 6-inch adjustment. Twenty strokes are made per minute.



Double-crank Press with a Welded Frame of Solid Rather than Tie-rod Construction



Gatke Molded Bearings Made for General Machinery Use

Gatke Molded Non-Metallic Bearings

Non-metallic bearings, which have been made for a number of years by the Gatke Corporation, 228 N. LaSalle St., Chicago, Ill., exclusively for steel mill service, are now available in a complete line for general machinery use. These bearings are composed of a textile base impregnated with synthetic resins. They are molded under high pressures and manufactured in various shapes and sizes to suit a wide variety of applications.

The bearings are molded from three basically different materials. Hydrotex bearings are intended for use when the bearings run in water or when water is used for lubrication; Lubritex bearings are designed for equipment that is oil-lubricated; while Grafitex bearings are self-lubricating and are especially made for slow-moving machinery where dirt and grit are encountered or where lubrication is likely to be neglected.

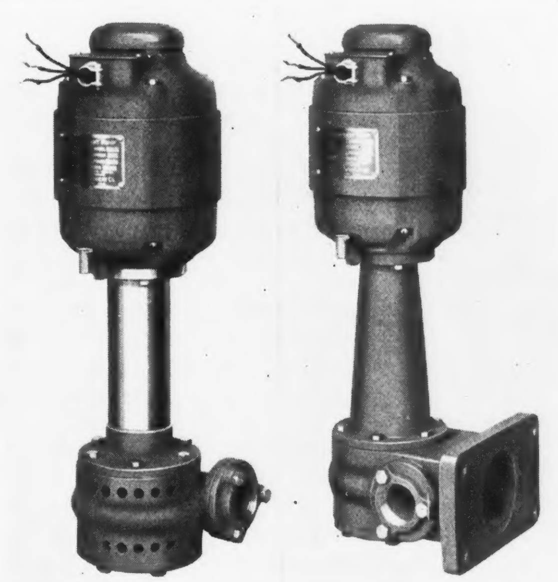
These bearings are not affected by ordinary acids, chemicals, solvents, or salt water; neither can they be softened by oils or greases. They are regularly available for journal diameters from 1/8 to 24 inches, and can be made in still larger sizes.

Ruthman Motor-Driven Vertical Pumps

Two motor-driven vertical pumps, one designed to be immersed in the coolant and the other to be installed outside the coolant reservoir, are shown at the left and right, respectively, in the accompanying illustration. These pumps are recent products of the Ruthman Machinery Co., 534 E. Front St., Cincinnati, Ohio. A twin-suction intake is one of the features of these pumps, each pump having two separate compartments which communicate independently with the upper and lower sections of the impeller. The two compartments are of equal size and maintain a hydrostatically balanced thrust with increased capacity.

Self-cleaning of the pumps is accomplished automatically when the flow is partially or totally throttled. The coolant does not come into contact with the bearings and sufficient clearance is provided for grit in the coolant to pass through harmlessly.

The air-cooled motor is equipped with a bowl-shaped disk fan that forces the air upward and outward through perforations in the motor. This eliminates damage that might be caused by excess oil from the top ball bearing and ejects dirt or chips that may find their way into the motor. The reversible impeller housing permits changing the relation of the intake to the discharge.



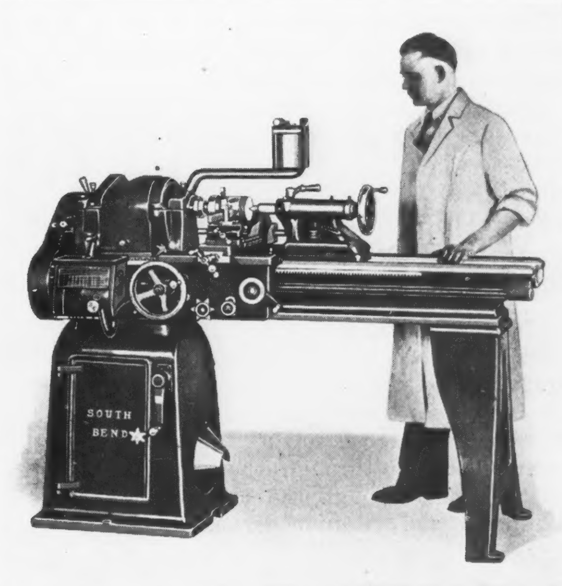
Ruthman Vertical Pumps for Installation Inside and Outside of Reservoirs

Lathe for Finishing Cam-Shaped Automobile Pistons

A lathe designed to machine both round and cam-shaped pistons is being introduced on the market by the South Bend Lathe Works, 426 E. Madison St., South Bend, Ind., for the automotive servicing trade. This machine can be quickly set up to finish pistons of practically any diameter, material, or shape, and of either straight or tapered types.

A cam-forming unit is mounted on the lathe carriage at the rear of the saddle. This unit is geared to the lathe spindle so that as the spindle rotates, it revolves a master cam. The cam oscillates the tool-slide according to its throw for turning the skirt of the piston to the desired shape.

By using a tool tipped with tungsten carbide, up to twenty-five sets of six pistons each can be machined in an ordinary working day to an unusually smooth finish and high polish. The equipment is available in three sizes to suit the needs of small, medium, and large shops.



South Bend Lathe for Machining Round or Cam-shaped Pistons

Spray Gun with "Feather Touch" Control

A Type MB spray gun is being introduced on the market by the DeVilbiss Co., Toledo, Ohio, which is provided with a new air trigger to insure easy operation. An air piston relieves the spring tension on the fluid needle when the air valve is open. This permits the use of a strong spring pressure to close the needle, and yet the trigger pull need be only strong enough to open the air valve. With this "Feather Touch" control, a light touch keeps the gun in action and the short trigger movement makes it unnecessary to stretch the fingers. An-

other feature of the gun is an unrestricted air passage designed to give better atomization than formerly.

Rotating Cam Limit Switch

Cutler-Hammer, Inc., Milwaukee, Wis., has made important changes in the design of the rotating cam limit switch which it manufactures for use with automatic feeder-catcher table control systems. The new design has split cams arranged in pairs to give any adjustment between from 4 to 8 degrees on the shortest cam, up to 180 to 360 degrees on the longest cam. Any cam can be adjusted without disturbing the others.

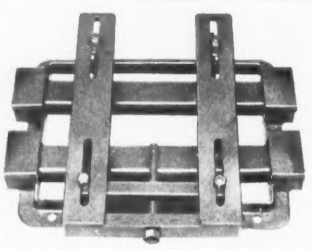
Willson Goggle with Transparent Cups

The cups or sides of a goggle recently brought out by Willson Products, Inc., Reading, Pa., for use in industry, are made of a transparent material so that the wearer can see through them. Light passes through the cups undimmed and permits normal eye vision, there being no feeling of wearing blinders. The goggle is spark-proof and is light in weight. It can be worn equally well with or without spectacles.

Goggle with Transparent Cups

GE Sound-Isolating Base for Motors

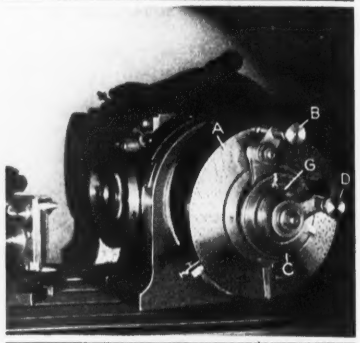
A motor base with sound-isolating features has been developed by the General Electric Co., Schenectady, N. Y. This base is provided with floating members suspended on a special insulating material and so enclosed and mounted that long life and freedom from damage are obtained. The motor is mounted in the same way as on a standard sliding base. Belt tension and motor alignment are maintained in the ordinary manner. The base is designed for each particular motor with which it is to be used. The illustration shows a typical design.



Sound-isolating Motor Base Made by the General Electric Co.

Cincinnati "Wide-Range Divider"

A "wide-range divider" that permits rapid selection of divisions from 2 to 400,000, and of any angle in degrees, minutes, and seconds, has been brought out by the Cincinnati Milling Machine Co., Cincinnati, Ohio, for use with the universal dividing heads made by the concern. Any of the divisions or angles can be obtained with the dividing head spindle in any position from 10 degrees below the horizontal to 50 degrees beyond the vertical. This facilitates such operations as the cutting of bevel gears; spiral gears can also be indexed.



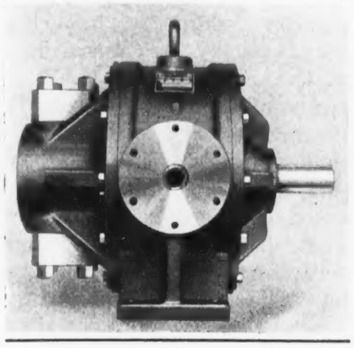
Dividing Head that Gives from 2 to 400,000 Divisions and Angular Settings to Seconds

The new device is a compact, self-contained unit built into the dividing head. It consists of the large index-plate *A* (see illustration), sector and crank *B*, small index-plate *C*, and sector and crank *D*. Crank *D* operates through reduction gearing in housing *G*, which has a ratio of 100 to 1. The ratio between the dividing head worm-shaft and spindle is 40 to 1.

A dividing head thus equipped can be set up for universal indexing in the conventional manner by using crank *B* only, in combination with the proper hole circle on the large plate. However, when the number of divisions required cannot be obtained by the conventional method, the wide-range divider is employed.

The ability to obtain any desired angle in degrees, minutes, or seconds is particularly useful in the tool-room when spacing keyways and slots or boring holes. The 54-hole circle in plate *A* and the 100-hole circle in plate *C* are employed. One turn of crank *B* equals 9 degrees, one space of the 54-hole circle equals 10 minutes, and one space of plate *C* equals 0.1 minute or 6 seconds. Ten spaces on the small plate obviously equal one minute.

Cincinnati dividing heads already in the field can be equipped with the wide-range divider.



Radial Hydraulic Pump Made by the Hydraulic Press Mfg. Co.

Radial Hydraulic Pumps

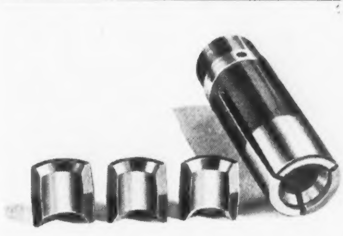
Radial pumps that generate pressure for the operation of hydraulically powered machinery are being placed on the market by the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. These pumps are made in six sizes having capacities ranging from 1 to 100 gallons per minute at pressures up to 3000 pounds per square inch. They are suitable for application to many types of presses, machine tools, welding machines, steel mill machinery, testing machines, and other equipment.

The pumps are of the positive-displacement, multiple-plunger, oil-pressure type. The volume of the output can be varied and the direction of flow reversed. While these pumps are just being announced generally to the trade, a number of them have been operating H-P-M Hydro-power presses for the last two years, so that there has been an opportunity of checking their performance in actual service.

Master Feed-Fingers for Automatic Screw Machines

Master feed-fingers with interchangeable and replaceable pads designed for handling round, hexagonal, or square stock have been placed on the market by the Sutton Tool Co., 2842 W. Grand Blvd., Detroit, Mich., for application to automatic screw machines. The work-gripping pads are seated in a recess in the master feed-finger. A shoulder at each end of the recess holds the pads positively and takes the operating thrust. A pin, free from thrust, prevents the pads from rotating.

The grip of the pads on the stock depends upon the number of splits in the master feed-finger and the number of pads. Above the 7/8-inch size, the feed-finger has three splits and the same number of pads, while above the 2 1/2-inch size, there are four splits and four pads. Because the pads are separate from the feed-finger, they can be made of a wear-resisting steel



Sutton Master Feed-finger and Interchangeable Pads

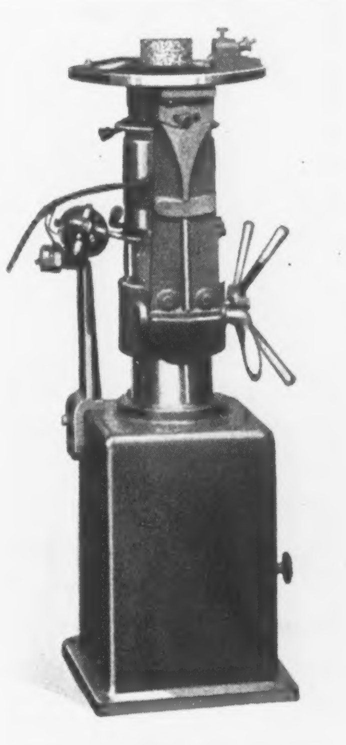
and hardened to any degree. If desired, they can be chromium-plated. Also because the pads are separate, the master feed-finger can be made of spring steel and subjected to only two heat-treatments. One master feed-finger with different sets of pads will handle practically the full work range of a screw machine.

Baker Contour Grinder

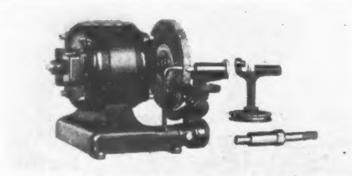
A machine designed for rapidly and accurately grinding all kinds of irregular shapes, both internal and external, is being introduced on the market by Baker Bros., Inc., Toledo, Ohio. This machine, as will be seen from the illustration, is provided with a vertical wheel-spindle driven by a vertically mounted motor. The armature of this motor reciprocates to give a vertical movement to the grinding wheel. This prevents the forming of shoulders on the wheel and insures a better cutting action. The reciprocating movement is obtained through a cam mounted directly below the wheel-spindle which is driven by a small independent motor. In dressing the wheel, the reciprocation is stopped by means of a snap switch. The reciprocating movement is 3/16 inch in length.

The table can be tilted to any angle relative to the wheel for grinding angular work. A pointer designates the setting. Since the table is "in the clear," the size of the work is not limited.

A radius grinding attachment can be provided to facilitate the grinding of convex radii on the end of rectangular or square stock, or special tool bits. Four grinding wheels are furnished as standard equipment. On the No. 2 machine there are 1/2- and 1-inch diameter solid wheels with a 2-inch face and 2 1/4- and 4-inch diameter cup-wheels with the same width of face. The machine weighs about 350 pounds.



Baker Grinder for Finishing Irregular Shapes



Grinder for Sharpening Routing Cutters and Engraving Tools

Wells Grinders for Various Tools

Two new grinders, a No. 130 for sharpening routing cutters and engraving tools, and a No. 150 for lathe and planer tools, have been added to the line of the Wells Mfg. Co., Greenfield, Mass. The No. 130 machine, which is shown in the illustration, will grind a routing cutter at the desired angle by inserting the cutter in the quill and then setting the quill in a locator or gage-block where it is aligned by means of a pin which enters a slot in the quill head. As the quill is pushed to the end of the locator, the cutter end is located against the hardened gage surface, while the flat side of the cutter is positioned on the locator blade. This insures not only that the flat side will be correctly positioned, but also that the point will project the right distance.

The No. 150 machine is intended for grinding and lapping tool bits of either high-speed steel or tungsten carbide. This machine consists of two units, one for grinding and the other for lapping. A special face-type grinding wheel is mounted directly on the motor shaft. This wheel is made in two parts, there being an outer ring of a coarse abrasive for rough-grinding and a central section of finer abrasive for finish-grinding.

On the right-hand side of the machine is a circular lap belted to the motor. This lap is also made in two parts, the outer ring being charged with an abrasive for removing all wheel marks from tools, while the central section is charged with a much finer abrasive for lapping the tools to a smooth, keen edge.

Improved General-Purpose Photo-Electric Relay

An improved photo-electric relay, which has a wide variety of applications in industry, including the starting and stopping of machinery, the control of mechanisms, and the operation of magnetic counters, has been brought out by the General Electric Co., Schenectady, N. Y. A feature of the new device is the convenience with which adjustments can be made. The adjustment knob, which formerly was located at one side of the tube socket, has been placed prominently on the bracket that supports the tube. This change affords easy access to the knob when adjustments are to be made.

Another feature is that by merely throwing a snap switch, the relay can be made to function when light is admitted or when the light source is cut off.

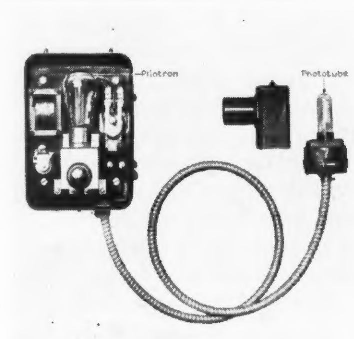


Photo-electric Relay for Many Industrial Uses

Do You Know

that a machine has been developed for producing steel tubing having a thin outer layer of stainless steel?—see page 638.

that oil-hardened gears almost invariably expand permanently in hardening, thus increasing the diameter of the pitch circle approximately 0.001 inch per inch of diameter?—see page 669.

that in metal-working plants an instrument like the astronomer's spectroscope may be used for determining the elements in castings and bar stock?—see page 625.

that a sphere is not the only solid having a constant or uniform diameter?—see page 663.

that the connecting-rods of a new eight-cylinder automobile motor have floating bearings, the internal surfaces of which turn on the crankshaft while the external surfaces turn in the connecting-rod bore?—see page 634.

that important developments in the properties and applications of new materials for the mechanical industries are described in the new Materials of Industry section?—see page 672.

The Cheerful Side

Evidence of an improvement in business is contained in the preliminary production report issued by the National Automobile Chamber of Commerce, which shows that the total April output of companies belonging to the organization was the highest in twenty-one months. The month's production was placed at 137,300 cars and trucks—a gain of 62 per cent over the preceding month, and an increase of 3 per cent over the corresponding month last year. This output exceeded the production of Chamber members for every month since July, 1931. The estimate, which was based upon reports of factory shipments to dealers, includes the figures of all but one major automobile producer.

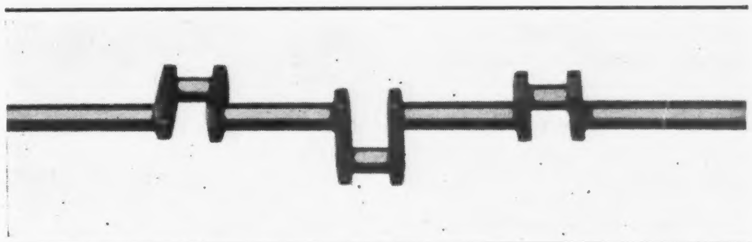
Black & Decker Mfg. Co., Towson, Md., manufacturer of portable electric tools and motors, announces that the month of April showed a consistent and substantial increase in business, not only in the electric tool line, but also in the electric motor line. The company has increased both the number of people employed and the working hours.

The United Engineering & Foundry Co., Pittsburgh, Pa., reports that it has recently received orders from the American Sheet & Tin Plate Co., the Jones & Laughlin Steel Corporation, and the Republic Iron & Steel Co. for equipment to produce light-gage material in strip form.

The Niagara Machine & Tool Works, Buffalo, N. Y., makers of sheet-metal working machinery and tools, report considerable activity in inquiries for machinery to make steel beer barrels.

Crankshaft Costs Cut Seventy-Five Per Cent

Arc welding was recently adopted by a concern in the Middle West for manufacturing crankshafts used to operate gate valves on hoppers. One of these crankshafts is shown in the accompanying illustration. They are made by merely cutting pieces of shafting to the required lengths and welding on the connecting members. The shielded-arc process is used, the equipment having been made by the Lincoln Electric Co., of Cleveland.



Crankshaft Made by Welding Pieces of Shafting to Connecting Members

Stair Treads of Rubber-Bonded Alundum

Safety treads for the stairs of industrial plants, office buildings, schools, etc., are now made by the Norton Co., Worcester, Mass., from "Alundum Aggregate," bonded in a base of hard tough rubber. "Alundum Aggregate" is obtained by mixing fine Alundum abrasive with special bonding clays. This mixture is pressed into blocks and vitrified. The blocks are then crushed and screened to the desired sizes. The resulting "Aggregate" consists of small grains of abrasive, held together by a hard glass-like vitreous bond that provides non-slip qualities in the finished tread.

A Standard for Machine Speeds

A proposed American standard for machine speeds has been distributed to the industry for criticism and comment by the Sectional Committee on Speeds of Machinery of the American Society of Mechanical Engineers. The adoption of standardized speeds will affect the manufacturing industries, and the greatest care is, therefore, being taken to develop this standard along lines best suited to the needs of American manufacturers. Those interested can obtain copies by addressing A. E. Hall, chairman, Subcommittee No. 1, American Society of Mechanical Engineers, 29 W. 39th St., New York.

Hardening Impression Dies

Impression dies used in the manufacture of silverware, jewelry, souvenirs and similar products, probably present the most difficult hardening problems met with in the diemaking field. Such dies range in size and shape from small stamping dies for sheet-metal work to large hammer dies for heavy sterling silverware. Generally cut in intricate and delicate patterns, the cost of these dies is high and any loss in hardening is a serious matter. Although such losses cannot be entirely eliminated, they can be minimized by using the right methods and equipment. How this is accomplished in giving this class of dies the proper degree of hardness will be explained in detail in two articles, the first of which will be published in the July number of MACHINERY.

NEWS OF THE INDUSTRY

Illinois and Wisconsin

American Manganese Steel Co., Inc., Chicago Heights, Ill., announces that it has granted the exclusive use of the registered trade name "Fahralloy," effective July 1, to F. A. Fahrenwald, and also that, in the future, all the nickel-chromium alloys made and sold by the American Manganese Steel Co. shall be known by the trade name "Amsco" alloys.

Mark R. Woodward has become associated with the Cement Equipment Division of the Babcock & Wilcox Co., 85 Liberty St., New York City. For the last fifteen years, Mr. Woodward has been assistant chief engineer of the Lehigh Portland Cement Co., Allentown, Pa. He will be located at the Chicago office of the company at 20 N. Wacker Drive.

American Machinery and Tools Institute, 40 N. Wells St., Chicago, Ill., elected the following officers at the last annual meeting: President, E. R. Prout, Teletype Corporation; vice-president, Frank Quick, Management Service Co.; treasurer, Craig B. Hazelwood; and secretary, George R. Tuthill.

Sundstrand Machine Tool Co., Rockford, Ill., informs us, relative to the note appearing in May Machinery regarding its agents in Canada, that while the Sterling-French Machinery Co. of Detroit, Mich., represents the company in the border cities of the province of Ontario, Canada, the J. B. Morrison Machinery Co., Toronto, Ontario, Canada, holds the exclusive representation for Sundstrand products in all the remainder of the Ontario territory.

G. G. Moran, for the last three years in charge of sales promotion in the South and Central American territories for the export department of the Four Wheel Drive Auto Co., Clintonville, Wis., has been appointed special representative of the company in Mexico, where he will be located for several months.

Michigan

John Bath & Co., Inc., 18 Grafton St., Worcester, Mass., have appointed the Walker Machinery Co., Inc., 411 New Center Bldg., Detroit, Mich., agent for the Bath line of ground thread taps and gages in the state of Michigan and the city of Toledo, Ohio. C. W. Dawson, formerly in charge of the Detroit office, will be connected with the Walker Machinery Co. in the capacity of assistant sales manager.

Alfred C. Rantsch has been appointed engineer in charge of sales promotional work of the die-casting plant of the AC Spark Plug Co., Flint, Mich., a division of General Motors Corporation. Mr. Rantsch has been connected with the die-casting industry for twenty-five years, in both production and sales capacities.

G. Beeler, consultant with the International Engineering Service, 6108 McClellan Ave., Detroit, Mich, has been sent to Europe to establish agencies and distributors for the purpose of placing American products on the European market. He will visit Belgium, France, Germany, Austria, Switzerland, and Czechoslovakia.

New Jersey and Pennsylvania

Worthington Pump & Machinery Corporation, Harrison, N. J., and Gamon Meter Co., Newark, N. J., have consolidated their operations in the manufacture and sale of meters through the newly organized Worthington-Gamon Meter Co. Sales headquarters for the company have been established at Harrison, N. J., but all manufacturing operations will be carried on in the Gamon plant at Newark. The officers of the new company are: E. T. Fishwick, president; G. H. Gleeson, vice-president in charge of sales; J. A. Bonnet, secretary; and R. R. Anderson, works manager.

The company announces the removal of its general and executive offices from 2 Park Ave., New York City, into a new building situated adjacent to the corporation's plant at Harrison. It is believed that this move will make possible better coordination of manufacturing and sales operations. The local sales office will be continued at 2 Park Ave.

Homestead Valve Mfg. Co., Inc., Coraopolis, Pa., announces that it has appointed the following exclusive representatives for the sales of the "Hypressure Jenny," a vapor-spray machine used in automotive, industrial, and building cleaning: Mine & Smelter Equipment Co., 7th Ave. and Santa Fé Tracks, Phoenix, Ariz., covering the state of Arizona; R. S. Armstrong & Bro. Co., 676 Marietta St., Atlanta, Ga., covering the state of Georgia; and Nixon-Hasselle Co., Carter at 13th St., Chattanooga, Tenn., covering middle and eastern Tennessee.

H. V. Erben has been appointed manager of the Switchgear Sales Division of the Central Station Department of the General Electric Co., with headquarters at the West Philadelphia Works. Mr. Erben succeeds J. W. Upp, who retired May 1 after thirty-two years of service with the company. Mr. Upp will continue in a consulting capacity.

New York

H. H. Moss of New York was awarded the Samuel Wylie Miller Medal for his "achievement in the application of fusion welding and oxy-acetylene flame cutting," at the last annual meeting of the American Welding Society. This medal is awarded annually by the Society for meritorious contributions to the science and art of welding. It was established in 1927 by the late Samuel Wylie Miller, who had been an outstanding figure in the development of welding from its inception. Mr. Moss is an engineer in the service of the Linde Air Products Co.

H. H. Moss, who was Awarded the Samuel Wylie Miller Medal for Achievements in the Welding and Cutting Field

American Arbitration Association, 521 Fifth Ave., New York City, announces the appointment of Pell W. Foster, Jr., to serve as representative of the electrical and general machinery industry on the Business Advisory Council of the Association. Arthur Notman has been appointed representative of the non-ferrous metals industry.

The purpose of the Business Advisory Council, which will be composed of one outstanding representative from approximately thirty industries, will be to assume the direction of efforts to coordinate and develop the use of arbitration in these industries in the gradual resumption of business activities as an aid in the revival of trade, the restoration of confidence, and the return of normal conditions.

Electric Hoist Manufacturers' Association, 165 Broadway, New York City, announces the election of the following officers at the last annual meeting: Chairman of the Association, Donald B. Patterson, vice-president of the Harnischfeger Corporation, Milwaukee, Wis., succeeding William White, secretary of the Euclid-Armington Corporation; vice-chairman, Frank F. Seaman, general manager of the Hoist & Crane Division of Robbins & Myers Sales, Inc., Springfield, Ohio.

Harold B. Madison has been appointed branch manager in charge of the eastern interests of the Clark Tructractor Co., Battle Creek, Mich., manufacturer of gas-powered industrial tractors and lift trucks. Mr. Madison will be located at 467 Canal St., New York City. He has been with the company for twelve years and has recently been field engineer in charge of surveys of material-handling problems and installations.

Charles Pack and Louis H. Morin announce the establishment of consulting offices under the firm name of Pack-Morin, Inc., at 261 Fifth Ave., New York City, where they will offer a complete engineering service covering every phase of plant management, including the solution of chemical, metallurgical, and mechanical problems. These men have specialized in the design of automatic machinery of all kinds.

Merrill G. Baker, who recently resigned as president of the Union Steel Casting Co., Pittsburgh, Pa., has been appointed executive vice-president of the Steel Founders' Society of America. T. H. Harvey, of the Ohio Steel Foundry Co., Lima, Ohio, is president of the Society, and Raymond L. Collier, managing director, with headquarters at 932 Graybar Bldg., New York City.

Foster D. Snell, Inc., chemists and engineers, have moved to 305 Washington St., Brooklyn, N. Y., where larger quarters have been provided for both offices and laboratories.

Earle Gear & Machine Co., 4709 Stenton Ave., Philadelphia, Pa., has moved its sales office in New York City from 95 Liberty St. to the Singer Building, 149 Broadway.

Ohio

C. W. Simpson, for several years work manager of the Windsor plant of the National Acme Co., Cleveland, Ohio, has been appointed vice-president and works manager of the company and will have charge of all manufacturing operations. Mr. Simpson first became associated with the Windsor Machine Co., Windsor, Vt., in August, 1909, and was placed in charge of the automatic department. In 1911, he was sent to Europe as special representative of the company, making his headquarters in England. In 1916, the National Acme Co. purchased the Windsor Machine Co. and Mr. Simpson was retained as representative of the company in Europe until March, 1927, when he was recalled to take over the management of the Windsor factory. Upon the recent merger of the Cleveland and Windsor factories, Mr. Simpson was transferred to Cleveland and has now been appointed vice-president and works manager of the combined plants.

A. E. Drissner, who has been, for some years, chief engineer of the National Acme Co., Cleveland, Ohio, has been appointed a vice-president in charge of engineering. Before becoming connected with the National Acme Co., Mr. Drissner represented a group of machine manufacturers in Europe. In 1910, the National Acme Co. engaged his services as European agent, and until 1914 he made his headquarters in France. During the spring of 1914, he was recalled by the company to take over the direction of the engineering department and new design. When the Windsor Machine Co. was purchased by the National Acme Co. in 1916, Mr. Drissner was appointed chief engineer, dividing his time between the two factories. These two factories were recently consolidated, and in his new capacity, he will have jurisdiction over the combined plants.

C. W. Simpson, Newly Appointed Vice-President and Works Manager of the National Acme Co.

A. E. Drissner, Vice-President in Charge of Engineering of the National Acme Co.

Cleveland Automatic Machine Co., Cleveland, Ohio, announces the election of the following officers at the last stockholders' meeting: President, Walter F. Brown of Toledo, Postmaster-General under the Hoover Administration, to succeed the late A. L. Garford; vice-president in charge of sales, Herbert E. Nunn; treasurer, A. L. Patrick; secretary, David L. Johnson; and general manager, H. W. Rupple.

William Laidlaw, Inc., Belmont, N. Y., manufacturer of metal-cutting band saws, has been purchased by Leon G. Rogers, of Cleveland, Ohio, and Fred Winterhalter, a former employe of the company. The name of the new company will be announced at a later date. The officers are: President, Leon G. Rogers; vice-president and general manager, Fred Winterhalter; treasurer, Pearl Winterhalter; and secretary, Edward N. Conrad.

Monarch Machine Tool Co., Sidney, Ohio, manufacturer of lathes, has removed its Chicago office from 547 W. Washington Blvd. to 622 W. Washington Blvd., where larger facilities are available for the exhibition and demonstration of equipment. The company also announces that its New York office has been moved from Room 857 in the Graybar Building to Room 413.

Burt F. Stauffer has been appointed general manager of the Miller Rubber Products Co., Inc., division of the B. F. Goodrich Co., Akron, Ohio, succeeding R. T. Griffiths. For the last eight years, Mr. Stauffer has been assistant general superintendent of the Goodrich mechanical division. He started work with the Goodrich organization forty years ago.

Republic Steel Corporation, Youngstown, Ohio, announces that the Dallas, Tex., district sales office of the company has been removed to 2322 Gulf Bldg., Houston, Tex. R. E. Lanier, district sales manager, and the present staff will be in charge of the new Houston office.

NEW BOOKS AND PUBLICATIONS

THE ENGINEER'S MANUAL OF ENGLISH. By W. O. Sypherd and Sharon Brown. 515 pages, 4½ by 6¾ inches. Published by Scott, Foresman & Co., Chicago, Ill. Price, $2.

This manual of English has been written to serve as a practical guide for engineering students and as a reference book on usage in technical writing for practicing engineers. It is divided into two main parts, the first of which treats of general problems in engineering writing; mechanical details, such as punctuation, abbreviations, hyphenation, rules for writing numbers, and capitalization; correspondence; report writing; and the writing of technical journals, bulletins, catalogues, and specifications. The second part contains specimens of engineering writing, such as periodic reports, progress reports, special information reports, examination reports (with and without recommendations), editorials, summaries and abstracts, book reviews, technical articles, catalogue descriptions, and specifications. There are five appendices treating of the preparation of manuscript and correction of proof; specifications for patents; the writing of theses; words frequently misspelled; and bibliography.

AMERICAN STANDARDS YEAR BOOK—1932-1933. 44 pages, 7½ by 10½ inches. Published by the American Standards Association, 29 W. 39th St., New York City.

This booklet lists the standards approved by the Association during the year 1932-1933, as well as the uncompleted projects. The various standards are classified under the following headings: Civil Engineering and Building Trades; Mechanical Engineering; Electrical Engineering; Automotive; Transportation; Ferrous Metallurgy; Nonferrous Metallurgy; Chemical Industry; Textile Industry; Mining; Wood Industry; Pulp and Paper Industry; and Miscellaneous. The prices of the approved standards are given in each case, following the complete title.

A COMPLETE TREATISE ON ISOMETRICAL DRAWING. By Albert J. Jameson. 28 pages, 6 by 9 inches. Published by the Worcester Boys' Trade School, Worcester, Mass. Price, $1.

The author of this book, who is director of the Worcester Boys' Trade School, has written a manual on isometrical drawing, especially adapted for use in schools. The principles of isometrical drawing are illustrated by practical problems, the thirteen problems presented being intended to give the student the required practice in making drawings of this kind.

A MAGNETIC BALANCE FOR THE INSPECTION OF AUSTENITIC STEEL. By Raymond L. Sanford. 6 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Research Paper No. 532 of the Bureau of Standards. Price, 5 cents.

EFFECT OF LATHE CUTTING CONDITIONS ON THE HARDNESS OF CARBON AND ALLOY STEELS. By T. G. Digges. 2 pages, 6 by 9 inches. Published by the U. S. Department of Commerce, Washington, D. C., as Research Paper No. 516 of the Bureau of Standards. Price, 5 cents.

A THEORY AND AN EQUATION FOR THE LIFE OF LATHE TOOLS. By Ragnar Woxen. 73 pages, 6 1/2 by 9 1/2 inches. Published as Bulletin No. 119 of the Proceedings of the Royal Swedish Institute for Engineering Research, Stockholm, Sweden.

GRINDING WHEELS. 28 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Simplified Practice Recommendation No. R45-32 of the Bureau of Standards. Price, 5 cents.

COMING EVENTS

JUNE 8—Thirty-fifth annual convention of the NATIONAL METAL TRADES ASSOCIATION at the Congress Hotel, Chicago, Ill. National secretary, J. E. Nyhan, Peoples Gas Bldg., Chicago, Ill.

JUNE 12-16—TENTH NATIONAL OIL BURNER SHOW in Chicago, Ill. Harry F. Tapp, executive secretary, American Oil Burner Association, Inc., 342 Madison Ave., New York City.

JUNE 19-23—Annual convention and exposition of the AMERICAN FOUNDRYMEN'S ASSOCIATION at the Hotel Stevens, Chicago, Ill. C. E. Hoyt, executive secretary-treasurer, 222 W. Adams St., Chicago, Ill.

JUNE 25-30—SIXTH MIDWEST ENGINEERING AND POWER EXPOSITION in the Coliseum, Chicago. Exposition headquarters, 308 W. Washington St., Chicago, Ill.

JUNE 26-29—Semi-annual meeting of the AMERICAN SOCIETY OF MECHANICAL ENGINEERS at the Hotel Stevens, Chicago, Ill., during "Engineering Week." Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 26-30—Annual meeting of the AMERICAN SOCIETY FOR TESTING MATERIALS at the Hotel Stevens, Chicago, Ill. C. L. Warwick, secretary-treasurer, 1315 Spruce St., Philadelphia, Pa.

JUNE 27-30—National Convention of THE SOCIETY OF INDUSTRIAL ENGINEERS at the Hotel Stevens, Chicago, Ill. George C. Dent, executive secretary, 205 W. Wacker Drive, Chicago, Ill.

AUGUST 28-SEPTEMBER 4—INTERNATIONAL AUTOMOTIVE ENGINEERING CONGRESS to be held at the Palmer House, Chicago, Ill., under the auspices of the Society of Automotive Engineers. John A. C. Warner, general manager, 29 W. 39th St., New York City.

SEPTEMBER 15-16—Annual convention of the NATIONAL ASSOCIATION OF FOREMEN at Akron, Ohio. Secretary, E. H. Tingley, Refiners Bldg., Dayton, Ohio.

OCTOBER 2-6—NATIONAL METAL CONGRESS AND EXPOSITION in Detroit, Mich., under the auspices of the American Society for Steel Treating. Secretary, W. H. Eisenman, 7016 Euclid Ave., Cleveland, Ohio.

OBITUARY

S. H. MARCH, for the last nine years export manager of Alfred Herbert, Ltd., Coventry, England, died at his residence 11 Beauchamp Ave., Leamington Spar, England, on May 5. Mr. March was well known in the machine tool industry in England and in this country, which he visited many times. He began his business career as an apprentice at the Birmingham Small Arms Co., afterward joining the sales staff of Charles Churchill & Co., of London. Upon the formation of the Churchill Machine Tool Co., Mr. March was appointed director and general manager of the firm, and also acted as vice-chairman of the Associated British Machine Tool Makers. In 1924, he resigned from the Churchill Machine Tool Co. and joined Alfred Herbert, Ltd., as a member of the executive staff, continuing in that capacity until his death. Mr. March was a member of the Council of the British Machine Tool Trades Association and served on the committee recently appointed by that body to assist the Import Duties Advisory Committee.

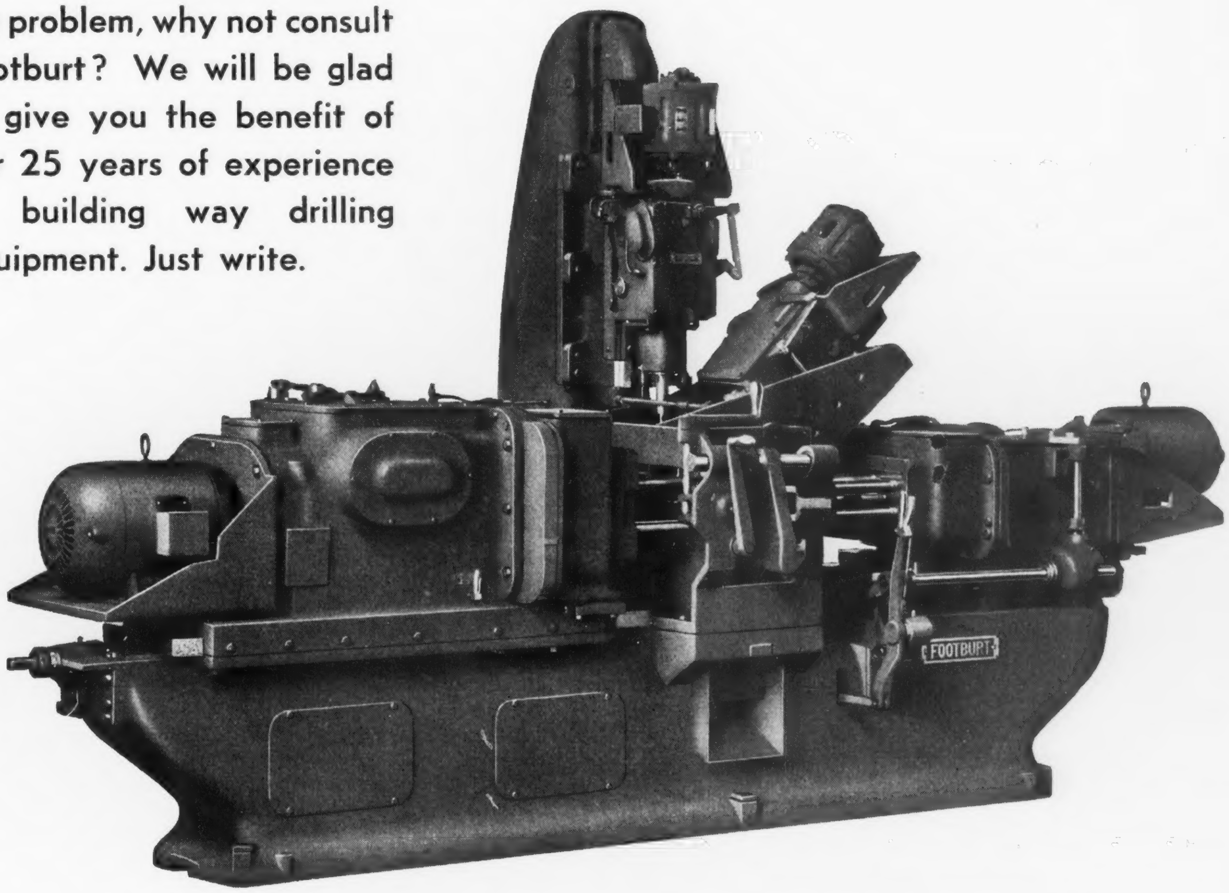
FOOTBURT

UNIT TYPE WAY DRILLS

This Four-Way Drilling Machine illustrates the flexibility possible in making up way drilling equipment with Footburt Cam Units.

There are three sizes of units, 14", 10" and 6" used, the size being determined by the travel required and amount of metal removed. One of the 6" units is mounted at an angle showing the possibility of using these units in any advantageous position.

If you have a difficult drilling problem, why not consult Footburt? We will be glad to give you the benefit of our 25 years of experience in building way drilling equipment. Just write.



THE FOOTE-BURT COMPANY

CLEVELAND, OHIO

Detroit Office: 4-151 General Motors Building

Chicago Office: 565 Washington Boulevard

Classified Contents of this Number